Food Values

What they are: How to calculate them

—

M. Mc. Killop

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WHAT THEY ARE AND HOW TO CALCULATE THEM

By

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Report of the British Medical Research Committee on Vitamines, Special Report Series, No. 38, H. M. Stationery Office, 4/-

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The Farmers' Bulletins, Reports and Year Books, published by the Agricultural Department of the United States Government, contain much information on food not to be obtained elsewhere. They are for sale by the Superintendent of Documents, Washington ; the Bulletins are usually 5 cents. each, but many of the earlier ones are out of print. A full list can be obtained by application to the Superintendent.

PREFACE TO THE THIRD EDITION

During the last few years the literature dealing with Food and Food Values has developed very rapidly, in proportion as the subject assumed more practical importance. During the War there were times when the whole food supply of Europe seemed to be in danger ; and the Allies on their part, the blockaded Germans on theirs, turned to their scientific experts with the momentous question : What is a sufficient diet for each person in the nation, each with his individual capacity, vocation and needs ? The information then at hand did prove to be useful and reliable. Although it is true that much was learned about diet during the solution of these very problems, and also true that advance in our knowledge still continues with almost as much impetus as then ; nevertheless, the facts and figures already accumulated about food values, when treated with the utmost skill and deliberation by statisticians called to the help of physiologists, proved a fairly safe guide to each nation's needs. These facts and figures helped to steer us through difficult days of rationing at home, as well as to keep our Army and Navy properly fed, and protected from diseases due to errors in diet.

The writer was fortunate enough to be called to service in the Ministry of Food from February 1917, to February 1920, and is not likely to forget the many things learned in its Statistical Department. Among many pleasant memories of personal help and co-operation, she would

like now to commemorate especially her intercourse with Sir W. Henry Thompson, of Trinity College, Dublin, who perished on the *Leinster* in 1918, to the grief and loss of many people on both sides of the water.

The scale on which work was carried on by the experts, when food was a national affair, was so immense that perhaps for the first time conclusions as to the average needs of people of all ages and occupations were put on a really sound basis. The effects of underfeeding generally, and of specific deficiencies in diet, were also studied on a sufficiently ample scale. The stimulus given to all efforts to overcome these evils was unprecedented. And the large scope of the inquiries removed every question from the domain of the study and the laboratory to that of the market-place and the Cabinet. The permanent result of this epoch ought certainly to be that the discussion of food requirements should never again be looked upon as a matter for faddists only. All the same, one cannot but be struck with the vagueness still prevailing in the mind of the public on the subject. One still sees letters to the Press demanding that housekeepers should be taught all about food values, but showing, at the same time, all the old tendencies to partizan and inaccurate statements, reinforced by a few new catch words, among which Vitamines are now the prime favourites.

It is hoped, therefore, that a re-issue of this little book may still meet a general need, as it seemed to do in 1916. Now that the nature of nearly every problem in feeding has altered, in its emphasis or its implications, the opportunity of re-writing much of the book, which was not possible in 1921, has been very gladly seized by the author in 1925.

The most important practical change in this edition is the substitution of English analyses of food for American analyses. Invaluable as the American work has been to us all, particularly the Farmers' Bulletins, including that classic in the literature of food values—Atwater and Wood's Tables, Bulletin No. 28 :—there was always the doubt whether American samples of food were near enough in character to English samples. And during the War the general need for direct immediate knowledge of the nature of our own foods was experienced most acutely by the Army Medical Authorities. This resulted in their commissioning Dr. Plimmer to make an exhaustive set of such analyses. The investigations were continued until 1920, so that the various sorts of food were finally analysed in a more normal and pre-war condition than was possible at first ; and the figures were published for the benefit of the world at large by H.M. Stationery Office in 1921. The work was, unfortunately, published too late for the second edition of this little book. But in this edition Dr. Plimmer's figures have been used wherever they could be ; the only drawback to them being that they were primarily intended for Army caterers, not housekeepers. Dr. Plimmer has been kind enough to help in the modification of some of the figures for the use of the private household.

While thus the present edition uses far fewer American data than before in giving the actual percentage composition of the foods, it (like the second edition) includes a large number of figures taken from recent American work which popularises and makes easy the conceptions of fuel values and of Calories. The writer is specially indebted to Mrs. M. S. Rose's *Feeding the Family*, both for new

presentments of the requirements of typical individuals, for the 100-Calorie lists in Table A, p. 117, and for the method of treating cookery recipes in Table B, p. 125 ; and she wishes to acknowledge this debt with much appreciation. It is, however, with some regret that she observes that, though the American nation is assumed, educationally, to have succeeded in imparting a sound apprehension of the meaning and use of decimals to all its citizens, it is here shewn to be using the utmost ingenuity in teaching them how to avoid and evade the use of them. As these cleverly simplified methods are, by permission, set forth in the following pages, it has not been necessary to give as much explanation as before of the manipulation of decimals. If readers can manage decimals, they will still do much more thorough and accurate work by using them ; if they cannot, they can use the attractive but not too accurate American short cuts.

Finally, Vitamines have been made the subject of the whole of Chapter V. and a good deal of the following chapter ; but nevertheless the reader who wants to know all about them must have recourse, at least, to a whole book on the subject, and at best to scientific periodicals up to date, in addition. But the new subject which needs the attention of all students of food is no longer Vitamines, but the differentiation of the various proteins. The chief emphasis in dietetics shows signs of shifting to this realm of interesting experiment and research (see ch. IV.). A new list of books follows. Among various changes and additions, Dr. Robert Hutchison's work, in its newest edition, still stands out as the *vade mecum* of all English food students. This book still draws from it both inspiration and material.

M. McKILLOP.

FOOD VALUES

CHAPTER I

INTRODUCTION

WHAT do people generally mean when they say one ought to know about food values? Apparently something like this—a pound of beefsteak obviously contains more nourishment than a pound of strawberries. Then it ought to be possible to arrange foods in order of merit according to the nourishment they contain.

But the enquirer, looking for such a list, finds the quest full of difficulties. We require different kinds of nourishment. The physiologist tabulates human requirements under the three headings of proteins, fats and carbohydrates, and states the amount of each required in grammes. We have to convert the figures into ounces or pints of ordinary food; and only in the case of fats is this arithmetical process at all simple. Then we find it necessary to follow in detail scientific discussion as to how far these three sorts of food can replace each other, just after we have taken so much trouble to separate them. It seems that their relation to each other must be settled, before we can arrive at the knowledge how much of each kind an ordinary person wants.

Postponing the consideration of this relation till the next chapter, we will first describe the three kinds of nourishment distinguished by the physiologist.

Fats. Fats are certainly more familiar to us than the other two kinds. We think first of meat fat, from beef, mutton, pork or bacon; then of butter or margarine; next perhaps of olive oil, the only vegetable fat which is commonly taken by itself as an article of diet, and, lastly, of the nut butters used chiefly by vegetarians. We do not find it difficult to believe that fats form a separate category in food-stuffs. This is partly because we are accustomed to buy and to use them separately. Fats and oils are also found, however, distributed in minute quantities through many animal and vegetable foods; as for instance in milk, cheese, nuts, yolk of egg, and even in lean meat. We look for fat in animal rather than in vegetable food, in which it occurs to a much less extent.

Carbohydrates. The name carbohydrate signifies to the chemist a compound of carbon, hydrogen and oxygen, with the two last elements in the same proportion as that in which they occur in water. Fats contain the same three elements, but less oxygen in proportion than the carbohydrates. The name carbohydrates is always used in treatises on diet, but it is in one way unfortunate, because certain compounds which come under the chemist's definition of carbohydrate (notably cellulose) are very little use to us as food. The carbohydrate foodstuffs are chiefly the sugars, and starch, which is closely connected with sugar.

Sugars. There is more than one kind of sugar, though, contrary to the general impression, beet and cane sugar show no appreciable difference in

chemical composition or in properties. Most fruits contain two closely allied sugars, which are different in composition from cane sugar, but are formed when a solution of cane sugar is boiled with any dilute acid. Therefore they are always formed to some extent in making jam out of the beet or cane sugar used, as well as being present in the fruit. The chemical names of these two are dextrose and lævulose ; we are familiar with the former as grape-sugar or glucose, which can be made artificially from starch. It is this sugar that we see in small crystalline lumps, in raisins. Lævulose does not crystallise as readily. Lactose is yet another kind of sugar—the much less sweet sort which is an important part of milk.

Our chief source of these sugars is from vegetables ; lactose is the only sugar of animal origin. Plants continually manufacture sugar from their liquid and gaseous mineral food. Starch is first made in the green parts of the plant ; and starch is stored up in seeds, roots, stems or tubers. Being insoluble in water makes it the convenient carbohydrate for storing. But it is converted into the closely allied substance sugar when it has to pass from one part of the plant to the other, because sugar is soluble in water, and can be carried in the sap or the cell fluids.

When we consume any form of starch as food, it must in the same way be converted into some form of sugar during digestion ; for one of the main purposes of digestion is to render food soluble. But sugar cannot be stored in the animal body any more than in a plant. In the human body there is a carbohydrate stored in the liver, called glycogen, which is a compound resembling starch. (See p. 84 note).

We may take our carbohydrate food as starch or as sugar, only in the former condition it gives more work to the digestive organs. But starch is more palatable to most people, especially to take in quantity ; probably because of the absence of very definite taste. It is the chief constituent, by weight, of the solid portion of bread, potatoes, oatmeal, rice and peas. Practically all our starch comes from vegetables, also all our sugar, except that in milk, and in honey—if we count honey as an animal product. Vegetable foods bring, in addition, some quantity of cellulose, varying according to the special preparation given to the food, and also with the part of the plant selected. Green vegetables, and most fruits, especially those with small seeds, contain a good deal ; whereas a substance like white flour contains very little. Cellulose is the substance of which the plant cell-wall is made ; one sees it in almost pure form in white paper and cotton, or in cork. Although it is a carbohydrate from the chemist's point of view, it is usually indigestible, and is finally expelled from the system. The cells of animal tissues have no cell-wall, and therefore animal food contains no cellulose.

Starch, when strongly heated, is converted into dextrin, another carbohydrate, which is digestible, being soluble in water, whereas cellulose is completely insoluble. We are familiar with dextrin as it gives the brown colour to the crust of a loaf. In the pure state its solution in water forms gum or mucilage.

Proteins or body-builders.

It is more difficult to realize the nature of a protein than that of any other constituent of food. The nearest substance to pure protein that we are likely to see among ordinary foods is the coagulated curd of milk, out of which cheese is made.

This consists chiefly of the protein called casein. Purified from other material, and then quite tasteless, it forms the basis of medicine foods such as Plasmon and Protose. But we need not think of protein in these rather remote and expensive forms. The chief constituent of muscle, which we know as lean meat, is a protein called *myosin*. The part of flour which is not starch, known as gluten, consists of at least two proteins—*glutenin* and *gliadin*. White of egg, often known as *albumin*, is almost pure protein. Peas and beans contain *legumin*, which is very like myosin.

It is for the chemist to tell us how these proteins actually differ from one another. Each is a combination of particular members of a series of compounds known as amino-acids. It should be noted that they are acids in a chemical, not in a popular sense; they are not to be thought of as sour or corrosive substances. An amino-acid is composed of carbon, hydrogen, oxygen and nitrogen, with always a small percentage of sulphur, and occasionally of phosphorus. There are 18 of these acids known at present to be constituent parts of the proteins, but only a few are present in each. Therefore the differences between the proteins are now explained by the chemist as differences in their make-up of amino-acids. The helpful simile suggested by Prof. Graham Lusk is, that we should look upon the 18 amino-acids as if they were letters of an alphabet, and upon the proteins as words, made up of chosen letters.

It has become clear that we need in our food more than one of these proteins or "words"; we need practically the whole alphabet of "letters." And this is a most noticeable fact; the process of digestion splits each protein into its amino-acids. It is these which are

absorbed separately into the blood, and are built up anew to form body tissues.

Experiments have been made in feeding rats and other animals on single proteins (combined with other forms of food which are not, like proteins, body-building). The results have been very often unfavourable, notably with the protein *zein*, the chief one which exists in maize. There is, to return to the simile, a missing letter in *zein*, and the search for it, the identification of it as the amino-acid tryptophane has been very interesting scientifically. But this is not really a consideration which need detain us, unless we should have a friend who insists on trying to live on maize alone. Ordinary diet will give all the "letters" we require; and the obvious conclusion is, that a mixed diet is best. It is not even to be inferred that on the whole vegetable proteins are inferior to animal proteins. Further work on the differences between proteins will be awaited with interest. Meanwhile the study of these differences must modify somewhat our views as to the whole quantity needed in diet, and also as to how far the current method of calculating the quantity present in each item is reliable. These important questions are taken up in the next chapter.

The dietetic view of food. The view of our food taken by a dietetician will become clearer to us if we compare it with the view of a mistress ordering a dinner, and that of a cook preparing it. Let us say that the mistress orders a stereotyped meal of this kind:—Boiled cod and anchovy sauce, roast chickens with forcemeat and bread sauce, potatoes, sea-kale, apple-pie, custard, and a cheese dish as savoury. She surveys her dinner under its separate courses by way of classification. The cook passes it in mental review, and, after noting

the simple items to be obtained, such as the fish, the chickens, the sea-kale, the potatoes, apples and cheese, she analyses further something after this manner. —Butter wanted for three sauces (anchovy sauce, bread sauce, white sauce for sea-kale), also for the pastry, unless some other fat is used, a little also for the cheese pudding. Suet for the forcemeat. Milk for the sauces, and for the custard. Bread for forcemeat and bread sauce, also for some toast under the sea-kale. Flour for two sauces, for the pastry, and for the cheese pudding. Eggs for forcemeat, custard and cheese pudding; sugar for apple-pie and custard. Now how much is wanted of each altogether?—This analysis of her review is not intended to be exhaustive, but only to show that she surveys the proposed meal under different categories from those of her mistress. Next comes the dietetician, the person interested in the meal as providing proper diet, and rearranges every dish suggested under the fresh headings of proteins, fats, carbohydrates. He will probably start with the cook's analysis, and rearrange that under his own headings. How exactly to do this is shown in the Tables in this book. The method followed is, obviously, to split up again meat, vegetables, milk, flour, eggs and so on into their constituents as he sees them, and estimate the whole quantity of these constituents in the meal.

Lastly, a chemist might take the analysis just made by the dietetician, and rearrange proteins, fats and carbohydrates under the headings of the chemical elements. He would split up proteins into carbon, hydrogen, oxygen, nitrogen; fats and carbohydrates into carbon, hydrogen and oxygen, indicating also the small quantities of other elements which appear in the foods. His

chief concern might be to estimate the carbon and the nitrogen supplied in the meal.

Practical people, who wish to provide and prepare meals with some judgment as to their dietetic value, need the power of surveying the meals according to all these categories in turn, although to follow out the chemist's at all thoroughly needs considerable knowledge of physics and physiology as well as of chemistry. They must realize that the problem is a scientific one, and lays many "ologies" under contribution. The last one to be remembered is Psychology, as important perhaps in feeding people as it is in teaching them. It is one thing to provide six people with a dish costing 6*d.*, in the manner of Mrs. Beeton and all worthy cooks after her; it is quite another to make sure that they are each going to consume their penny portion. "How if he will not?" is the final problem of the home caterer.

In concluding these introductory remarks it is necessary to remind the reader that the scientific study of nutrition, particularly by means of experiment, is a comparatively new one, and that much work has still to be done. Every year new discoveries are being made. In consequence, although so much work of inestimable value has been done, every investigator must keep an open mind, and be ready to modify his first conclusions if there is sufficient evidence for him to do so. Students must also keep their minds open; and keep their eyes open to acquire new information from reliable sources. Meanwhile many a student may be a woman of action; she has to be feeding people while questions hang in the physiologist's and chemist's balance. She must act on the present stock of assured knowledge.

Unfortunately many of the small pamphlets on food

are written to recommend or vindicate some theory of diet. Any treatises containing absolute dogmatic statements about the value of foods, with conclusions drawn from them after the manner of a mathematical demonstration, are to be distrusted. A writer with some contention to support is quite likely to have seized favourable figures without inquiring too closely into them, and may give some that have been superseded, or some that are not yet fully established.

Figures given for the analyses of different food stuffs are usually averages from a large number of samples. An actual piece of bread or meat may differ quite noticeably from the average. We cannot therefore work out our arithmetical additions with an accuracy similar to $2+3=5$.

In the same way if figures are given for the requirements in food of an average man of known weight and occupation, a particular man of the type may be found who will do better on a somewhat different amount. We must all learn to work by averages if we are to make use of any tabulated and generalized information on nutrition, and learn to make afterwards some judicious allowance for slight differences in the actual problems before us. We shall find ourselves prone to each of the two opposed mistakes in turn, if we are not watchful; one the exaggeration of individual differences, the other the adoption of the average figures in a hard and fast way, as if the Tables from which they come had the same sort of veracity as the multiplication table. It is true that people usually make far too much of departures from the average in personal traits about eating; and equally true that if they see a figure giving the *average* percentage of fat in cheese, they are apt to pigeonhole

this information in their brains as if it were applicable to any cheese whatever.

NOTE

It may possibly be of use to add a note on the use of percentage numbers, merely as a matter of arithmetic. Suppose it is desired to ascertain the composition of a sample of food. Small portions of it may be assigned to different workers at the same time, or used by the same person at different times, and a variety of chemical methods used to find the amounts of protein, fat, sugar, etc., in each piece. As the original weights were different, these separate amounts will come out different. How can they be compared, and combined into one average result? We get an average by adding together strictly comparable results, and dividing the sum by the number of results. But results are not strictly comparable as they are obtained. We might call the original weight of meat, for instance, always 1, and say $\frac{1}{4}$ or $\frac{1}{6}$ of that was fat, and so on. But fractions are very awkward, because they are difficult to add together; that is, vulgar fractions are. Decimal fractions are much more easily added. But if we use them, i.e. tenths, hundredths, and so on, we might as well take 100 as the original weight instead of unity. Then we shall have whole numbers in place of tenths and hundredths, and begin decimals only for thousandths.

To take an example, of two pieces of meat one contained $\frac{1}{4}$, the other $\frac{1}{6}$ of fat. In decimals these figures would be .25, .167. Expressed as percentages, or fractions of 100 they would be 25 per cent. 16.7 per cent. The average of the two would be $\frac{41.7}{2} = 20.85$ per cent. The last figure (5) is the ten thousandth part of the sample of meat, and therefore might be neglected unless very large quantities were in question. Percentage analyses are often given only to one decimal place, and that will be enough for computations on a small scale.

Some of us, who have never been taught to use decimals in practical issues, are afraid of them because of their apparently ungovernable propensity to "go on for ever." No practical investigator has any time, nor has he occasion to go on with them. He is aware that each succeeding figure has, by its place, only $\frac{1}{10}$ of the importance of the one before it, and that therefore the figures soon cease to affect practical issues.

CHAPTER II

OUR NEED OF FOOD. HOW THE DIFFERENT KINDS SATISFY IT

Food compared to fuel.

THE food given to a human being is very often compared to the fuel supplied to a steam engine; an analogy giving direct sanction to the slang expression "stoking," for partaking of a meal. But there is a little confusion in the comparison. It is rightly believed that food keeps us warm, it creates heat in us in some way. Now, though fuel creates heat in a steam-engine, it is not put there for that purpose, but in order that the engine should perform work. We know it is the heat that produces the work. The human body needs first to be heated, or rather warmed; and secondly to be able to do work. A large amount of heat is needed to keep up the proper body temperature, and a variable extra amount is needed according to the exertions made by the person. The work done by the body is not only that which the individual chooses to do, such as walking, lifting or otherwise using the muscles; it includes also involuntary exertions that are always going on, such as the beating of the heart to propel blood, the expansion of the lungs, action on the food during digestion, and so on.

An engine also may be put to do work of various kinds. But all kinds are alike in this, that each is

produced by the heat in the engine, and that this heat comes from burning fuel. Is our food then burned like fuel? The process is practically the same chemically; food is, finally, for the most part oxidized by the oxygen taken into the lungs; only the action is more gradual, and sets free heat at a slower rate.

Food measured in terms of heat

It is most important to realize that heat gives power of doing work. This power is known as energy. There are many ways of measuring energy, as it can always be estimated in terms of the work done, of whatever kind that may be. But another way is to measure it in terms of the heat taken to produce it. This last way is by far the best for the estimation of the needs of the body. If we express them all in terms of heat it does not matter that part of these needs are for heat itself and part for energy produced by heat.

The measurement of heat.

But how do we measure heat? In ordinary life we do not, as a rule, measure it at all; we measure temperature. We speak of 60° Fah. as the temperature of a room, or of 212° Fah. as that of boiling water. However, we know quite certainly that one quart of boiling water holds more heat than one pint, without putting them to a test, such as finding which would warm a bed best, when placed in a hot-water bottle. Probably we can also realize without proof that a quart should contain twice as much heat as a pint at the same temperature. Further, we can comprehend that a quart of water which is 100° Fahr. warmer than a bed ought to warm it about twice as well as a quart only 50° Fahr. warmer.

If we may be allowed to assume that these relations

hold, and can be proved mathematically accurate, we shall understand that heat can be measured by the amount taken to heat a certain quantity of water a certain number of degrees. This method is rather more convenient than expressing it in the reverse way, as we did in speaking of the use of a hot-water bottle. Then we were considering the heat given off by a quantity of water when cooled through a number of degrees. This is exactly equivalent to the heat originally taken to raise the water to that degree of heat. For accurate definition the weight of water, not the volume, is fixed, and usually the temperature is measured in degrees Centigrade, not Fahrenheit.

A convenient unit for measuring heat is the amount taken to heat one kilogram of water one degree C.; or, more precisely, to heat it from 0° to 1° C. This unit is called a Calorie, but with a capital letter, because it is known to scientific men as the large Calorie. The small calorie is the unit used in delicate heat experiments with small quantities. It heats only one gram of water through one degree, not a kilogram, which is 1,000 grams (about 2¼lbs.). The volume of a kilogram of water is about 1¾ pints. Thus we can say a Calorie is the heat taken to heat 1¾ pints of water 1 Centigrade degree; and it has also been roughly defined for practical people as the heat which will raise 1*lb.* of water 4° *Fahr.*

Fuel value. Our requirements in food can then be stated in Calories or in "Fuel Value" for each person per day. This is because food resembles fuel; and the value of what we eat can be measured by the amount of heat it can produce in the body. We need take no notice of the fact that the combustion

takes place slowly and at a comparatively low temperature; or of the fact that some heat goes to keep up the temperature of the body (98.4° Fahr.), while the rest is used up by our doing muscular work, voluntary or involuntary.

One great advantage in regarding food merely as supplying Calories of heat is that, for any given kind of food, a figure can be given for the exact amount of Calories produced when one gram, or one ounce, or one lb. of it undergoes combustion in the body; and therefore the effects of the different kinds of food taken can be added together into one total.

Food for body-building.

We must now consider food in an aspect in which it is different from fuel. When an engine shows signs of wear in any part, it must be stopped and repaired before it can work effectively again. The human machine must keep on going if it is to continue to exist; voluntary work may be reduced to a minimum, but involuntary work, and the production of heat, must continue. The only method by which the body can replace—from outside—the wear and tear of its material is by the consumption of food. This is also the only means by which it can grow.

All foods are not equally valuable for the purpose of body-building, that is, for the two processes of replacing old tissues, and creating entirely new tissue. We have therefore to distinguish different kinds of food, surveying them under an aspect in which one cannot replace another.

Proteins as body-builders.

The most important constituent of food for the purpose of body-building is the substance referred to in the last chapter as

protein,* or rather, the proteins. We saw that proteins formed the chief part of flesh or muscle, i.e. of lean meat, though they could be obtained from many other foods. It seems obvious, however, that lean meat should be capable of forming new tissue, as it is natural that flesh should replace flesh. It will be equally obvious that milk can make new tissue, as babies and young animals rapidly increase in weight while it is their sole diet. And the material in an egg must be tissue forming, as during incubation the chick is formed with its aid, by the growth of the tiny embryo which is so small a proportion of a fresh egg.

Proteins as fuel. But it will suggest itself after a moment's reflection that flesh, at least, can also be used as a source of heat and energy. Suppose persons are undergoing actual starvation. They still keep warm, though perhaps with difficulty, and they are not incapable of motion. Where does their energy come from? It is true that any fat which may have been deposited in the body gradually disappears; but the tissues themselves also waste away, more rapidly in a thin person than in a fat one. The actual flesh of the body can then be used to give energy, so it seems clear that any meat we eat can do the same. Meat and all the other forms of protein we get in our food will give energy when oxidized, just as carbohydrates and fats do. It is nevertheless extravagant to get one's

*Mulder, in *Vegetable and Physiological Chemistry*, 1845, says that the name protein is given to a definite substance "because it is the origin of so many dissimilar bodies, and is itself a primary substance." This view is of course now impracticable, as protein is *not* one definite substance; but it shows that the importance of the proteins is their readiness to undergo chemical change to form material essential to life processes.

heat and energy from protein; extravagant in the housekeeper's sense, because food that contains a lot of protein is generally expensive, and also from the view of the body's economies, if protein is the only food that builds up the tissues. The other kinds of food are therefore often referred to as "protein-sparers."

Sources of protein.

From what part of our food do we get the proteins necessary to us? We have mentioned meat, milk and eggs, and may at once add fish. Cheese can be put into the list, but not butter. The curd which makes cheese contains practically all the protein there is in milk, which protein remains in the skim milk when butter is made. But we must not rashly conclude that foods of animal origin are necessary for body-building; though it is undoubtedly true that a "lacto-vegetarian," i.e. one who adds milk, cheese and eggs, with butter, to his diet, is more secure of his supply of protein than is a strict vegetarian.

All vegetable food, where there has been no separation or isolation of definite products,—in fact all kinds of seeds, roots, tubers, stems, leaves and fruits as we eat them—contain some protein, although the quantity is very variable and often very small. Seeds of the sort immemorially selected for food, such as the cereals, the peas and other pulses, and nuts, contain most; indeed pulses and nuts are quite comparable with meat and cheese; whereas vegetables and fruit contain very little.

On the other hand, sugar, being a carefully isolated and purified product, contains absolutely no protein. Starch preparations like cornflour and arrowroot contain none. The same may be said of purified oils and purified animal fats.

Water essential for new tissues. Is protein the only essential for replacing body tissue? Water is certainly essential; as about two-thirds of every tissue consists of this substance. But we are not put to any trouble in obtaining it. The solid food we eat on the average is about half water, and we all have the habit of drinking water, or some liquid which is nearly all water.

Mineral salts essential Further, practically all our food contains some mineral salts, which are equally necessary for the construction of tissue. The easiest way to find out what mineral constituents exist in any sort of food is to burn a sample of it as completely as possible. When all the black charred material has been burned away the small quantity of white or grey ash remaining is the mineral part of the food. It consists generally of potassium, sodium, calcium, iron and magnesium, occurring as phosphates, carbonates, sulphates and chlorides. The proportion in which these are present, and the actual quantity present, vary very much in the different sorts of food. So it often may be important for particular reasons to know in which mineral constituents some special food is rich, and in which it is poor. But if we consider the constitution of animal and vegetable stuffs generally, and compare it with that of our own tissues, we find that the mineral materials used are very much the same all round; the same substances are needed, speaking broadly, by every sort of living matter. For instance phosphorus and sulphur enter into the constitution of protoplasm (living matter) itself; salts of potash, soda and iron are essential to the processes by which life continues; and lime and silica are the materials from which hard resisting structures are built.

Plants, animals and human beings are then continually passing these mineral salts on one to another. But it must not be forgotten that when we obtain them naturally in our food they are not in the simple chemical form in which they are in ash, they are in complex combination with organic material; and it is these combinations with which our digestive system is prepared to deal. It would not be at all the same thing for us to eat the mineral ash, it might be quite useless to us, though it cannot be said dogmatically that it is certainly useless, considering that we take, and require, salt in the mineral form. Plants, on the other hand, can use this mineral ash, if it is returned to the soil, and there passes into solution. It forms good manure, i.e. plant food, but is not good animal food.

However, the main point about the minerals in our diet is that we do get all that we need of every necessary chemical salt in an ordinary mixed diet. In fact we usually get more than we need, and the body has to excrete the surplus. It is only when the diet is for any reason very limited in range, and many varieties of food are excluded, that trouble begins for want of certain mineral constituents.

Vitamines.

But the difficulties caused by limiting diet to one or two forms of food are by no means ended when we have secured the right mineral salts.

As soon as experimental dieting reached the stage of supplying highly purified isolated constituents of food, even material artificially prepared instead of being directly derived from animals or plants,—as soon as, in fact, experimenters got rather near to giving proteins and carbohydrates instead of natural foods—new

troubles appeared. Rats and guinea-pigs fed with what seemed correct and sufficient food stopped growing, or could not produce offspring, or developed diseases, or simply died. Something was missing; yet so slight was the actual amount of that something that, in the case of rats, about one half-teaspoonful of milk per day given to each was enough to get them back to normal condition again. Further experiment showed that the omission of certain food stuffs could produce definite disease, even where the diet was ample in quantity, and not devoid of variety. Scurvy had long been known to be a deficiency disease of this kind, because it was characterized by appearing only where there was shortage of fresh vegetables and fruit. Again, the rather baffling Eastern disease of beri-beri was traced quite certainly to the removal of the outside coating of the rice grain in more refined processes of preparing it for the people for whom it is almost the sole diet. "Polished" rice brought on this disease among rice-eaters; unpolished rice, with an outer skin still on the grain, did not. But now the question was,—and still is—what are the substances concerned in these efficiencies and deficiencies of diet; the substances whose presence or absence matters so vitally? The name vitamine was given by one of the first experimenters, Dr. Funk, a Pole. The latter half of the name is unfortunate, as it seems to indicate that the chemical nature of the substances is known to resemble that of the large class known to a chemist as amines; but the significance of the former is not misleading, even though directed to two aspects; one that a vitamine is a substance necessary to healthy life, the other that, as far as we know, it must come from natural food obtained from living organisms. But

great care is necessary in forming a conception of such a substance. The history of chemistry has already shown that to postulate any factor that seems essential as a "vital principle" leads to vagueness and fogginess which hinders all helpful discussion or research.

The whole story of vitamines during the last few years has attracted so much investigation and attention that it seems best to sum up the main points in a separate chapter, and content ourselves now with adding them to the list of materials necessary in our food, both for growth and for health, with the reservation that the quantity of each of these substances required is so minute, it seems, that they are better considered not as actual food, but as what may be termed "accessory factors" to food. Thus, besides a proper variety of proteins, there are three other requisites for body-building: water, mineral salts, and vitamines—probably three in number if not more.

Fuel value of the three kinds of food.

We must now revert to the primary use of food for which all three kinds serve—the production of heat and energy. Proteins are not entirely combustible; the nitrogenous part is separated, with a certain amount of carbon, hydrogen and oxygen, as urea in the urine; the remaining non-nitrogenous part is entirely oxidised, as are the fats and carbohydrates. This part of a protein produces about as much heat as a carbohydrate in combustion, whereas the fats produce, weight for weight, rather more than twice as much. The actual quantities have been estimated many times over with the greatest care; the generalised result is:—

1 gram of	Protein	in combustion	produces	4.1	Calories
1 „	Fat	„	„	9.3	„
1 „	Carbohydrate	„	„	4.1	„

Or in ounces thus :—

1oz. Protein	produces	116	Calories
1 „ Fat	„	263	„
1 „ Carbohydrate ..	„	116	„

It is quite usual to allow for a small percentage of waste heat, and to give slightly lower figures for Calories *available.*

	Production of Calories. per gram	per oz.
Protein	.. 4 ..	.. 113
Fat	.. 9 ..	.. 255
Carbohydrate ..	.. 4 ..	.. 113

It may be asked—has our classification of foods been complete, if we keep to the three headings given. Surely some ingredients have been left out ; for instance, pepper and mustard ? There are many ingredients of this kind that are not food, if by food we mean a substance giving heat, energy, or body-building material. But they are often very important to appetite, and thus to digestion ; or they may act as nerve stimulants. At any rate they add very considerably to our interest in food. Among substances of this nature are :—

1. Nitrogenous compounds which are not proteins, but which give the pleasant appetising flavour to meat and meat extracts.

2. The acids and essential oils found in fruits, particularly in the juice, giving flavour and perfume. For instance, the juice of a lemon contains several acids ; the rind contains a non-acid essential oil which is separated as " essence of lemon." Under the same heading we may mention the strong-tasting constituents of savoury herbs, and of flavouring seeds like carraway and anise.

3. Pungent compounds such as occur in mustard, cresses, horseradish ; also in pepper and other spices.

4. Stimulants such as are contained in tea, coffee and cocoa ; which, if isolated, approximate to the nature of medicines rather than food.

All these substances are, like foods proper, composed of carbon, hydrogen and oxygen, with occasionally nitrogen and sulphur as well, but those that are nitrogenous cannot be transformed into body substance. Those that are not, though they may finally be broken up and oxidized, are so small in actual quantity that their products of combustion are negligible and do not give any calculable food value to the original material.

Some writers have also pointed out that certain forms of food serve physical rather than chemical purposes in the body, and have called them regulative foods. Thus bulky foods containing cellulose or other harmless space-filling material, assist in intestinal movements ; hard foods are valuable for the teeth, and so on.

Alcohol as food. If food is valued chiefly as, and because, it undergoes combustion in the body, is not alcohol a genuine food ?

Small quantities of alcohol will serve the purpose of food, i.e. will serve to warm the body and to help it to carry on vital functions. One gram of alcohol in complete combustion gives 7 Calories (thus coming above a carbohydrate and below a fat). It may also be said that alcohol has this advantage, that it passes into the blood more quickly than ordinary food, especially if taken into an empty stomach. So it is easy to see how a dose of alcohol will restore warmth and vitality in a case of collapse. But it must always be remembered that alcohol can be given only in small doses for this

purpose. Otherwise it accumulates in the blood; it takes some time to get rid of it, and meanwhile other effects the reverse of salutary are being produced. These effects cannot be discussed here, where an attempt has been made merely to give the accredited answer to the direct question whether alcohol is to be considered a food. A good deal of experimental work has been done in late years on the varied effects of alcohol on the human body (see list of authorities, p. viii).

The food value of alcohol for a normal individual is unimportant; for the quantity which can safely be taken will replace very little ordinary food. A really safe quantity at one time is said to be 16 grams, giving 112 C. The maximum which medical opinion would allow would be 25 gr., giving 175 C. The dose recommended in cases of weakness, or complete want of digestive power is about 8 gr. per hour, giving 56 C., barely sufficient for basal metabolism, as we shall see in the next chapter.

CHAPTER III

THE NUTRITIVE REQUIREMENTS OF THE AVERAGE MAN

We are now to arrive if we can at a definite figure for the amount of nutrition required by the body daily, first in terms of Calories, for the whole of the food needed, and secondly, in terms of the weight of protein sufficient to replace the wear and tear of the tissues, and to allow for growth.

This may be a disappointment to anyone who would like the requirements given in so many pounds of food per day. But it is obvious that a statement that a person can live on a certain quantity of milk by itself, or on so many eggs, apples or potatoes, or slices of meat or even loaves of bread, is really useless, because nobody is going to do so. The total weight of the foods we eat will depend entirely on how we choose them. Concentrated foods are usually more expensive than others, so, to a large extent, the cheaper the diet the more must be eaten, if the person is to get enough. Vegetarian diet also means usually greater weight of food because of the amount of cellulose, and other reasons. A sufficient diet containing a fair proportion of meat and butter will be about 2lbs. per day per adult man; a cheap vegetarian diet without meat or eggs, and consisting chiefly of bread and potatoes, may be 4lbs. or over.

How figures are obtained. How is it possible to get reliable figures for Calorie and Protein requirements? Physiologists have attacked the problem in three different ways. The first way is to weigh or estimate the incomings and the outgoings, while the body remains at constant weight. The whole of the outgoing substances excreted by the lungs, skin, kidneys and bowels, can be measured and analysed. These substances, if we subtract the refuse of the food, represent the results of all the combustion, and all the breaking down of tissue that goes on. Close study has also been given to these excretions when the body is not at constant weight; during starvation, and during very severe exertion. Researches of this and the former kind form part of the study of Metabolism. The meaning of this word is—the changes produced in material from the exterior by the action of living cells, whether this material is built up into some more complex substance (anabolism) or broken down to a simpler one (katabolism). This small book can not make any pretence to treat of metabolism, nor is the writer competent to do so. Yet any one who wishes to study nutrition properly must devote some considerable time and attention to this aspect of the subject, even though it entails some preliminary work in physiology and chemistry. We shall not venture here to touch upon the very large domain of knowledge and speculation involved in the investigation of what becomes of the food that is eaten.

The second method of ascertaining nutritive requirements is to try experiments in diet on men and animals. These experiments are usually carried on under conditions such that again the excreta are all examined, and quantitative results obtained; so that the work often

throws great light on metabolism in detail. But often simple conclusions can be drawn about the effect of the diet on the weight, health or activity of the animal concerned.

The third way is to collect statistics about the actual food taken daily by people in various climates, doing various kinds of manual or other labour ; and to compare and tabulate the figures obtained. It is assumed that the average person free to choose will eat about the right quantity, and select about the right sort of diet, to keep himself "fit" ; that is, healthy, and strong enough for work ; though it is true that medical practitioners find that many people contradict this assumption. Nevertheless figures obtained in this way have great weight and value, if they are founded on a sufficiently large number of cases. The statistical work of this kind done by scientific men during the War has already been mentioned as epoch-making. The numbers of people about whom information could be tabulated was larger than ever before, and, also, the peculiar conditions gave opportunities for observing the effects of changes or limitations in diet on actual mortality, health and power of work. We shall give a general survey of well established results in this chapter, beginning with the earliest reliable figures ; and then give a brief resumê at the beginning of the Tables (p. 72).

Calories necessary. It is not possible to quote a fixed and unvariable number of Calories for the daily needs of a normal man. The number depends first on the area of the surface of his body, and secondly on the amount of manual labour he performs. The heat needed will vary proportionally with the area of body

surface, rather than with the person's weight, because the chief part of the heat lost by the body is from the surface, whether covered or uncovered. Nevertheless, it is customary, as much easier, to take the need in Calories as roughly proportional to body weight. Children must be allowed more on this account, though, because the area of the surface of their small bodies is greater in proportion to their weight than it is in adults. Also, a thin person has proportionally more surface to his weight than a stout person.* But the greatest variation in the number of Calories will always be caused by variation in muscular exertion.

Basal metabolism. An average man is considered to weigh 70 kilograms or 154lbs. If we imagine him to be resting in bed he will need the very minimum of Calories to sustain him ; this is called by experimenters his *basal metabolism,* and is under 2000 per day. The physiologists of the Inter-Allied Commission fixed it, early in 1918, as 1687 Calories in 24 hours. The same man sitting all day in a chair will need a little over 2000 Calories ; if he is moving freely, living a sedentary life on the whole, about 2,500. The Commission mentioned above decided to take the metabolism of the same man doing moderate physical work as a little over 3000 Calories. But there ought to be allowance made for some waste in the diet, some food not utilised or digested, so the final conclusion was that the general daily ration per average man should be 3300 Calories, thus giving about a 10% allowance for waste.

*The area of body surface of a normal man has been calculated as 1.772 sq. metre : of a normal woman 1.511 sq. metre ; of a boy or girl ten years old 1.000.0. In the vernacular, a man's body surface is about $1\frac{3}{4}$ sq. yards, a woman's $1\frac{1}{2}$, a child's (10 years old) 1 square yard.

This quantity has been arrived at by many investigators, both those judging by statistics and those judging from physiological evidence, and may be considered very well established, according to Prof. Starling's recent book " The Feeding of Nations." In this a typical calculation is given for a man 8 hours in bed, with basal metabolism going on, 8 hours at ordinary muscular work, and 8 hours at meals, going to and fro and recreation. The total thus arrived at was 3169 Calories. The Royal Society's computations used by the Inter-Allied Commission to give the amount to be added to the basal metabolism according to the occupation followed were :—

Sedentary	up to 400 C.
Light work	400-700 C.
Moderate	700-1100 C.
Heavy	1100-1700 C.

This rough estimate would give about 3500 Calories as the amount needed by a normal heavy worker ; and the figure is supported by the list of Calories in farmers' diet compiled from statistics by Prof. Atwater (U.S.A. Department of Agriculture).

	Calories in daily diet
Farmer, Connecticut	3410
„ Vermont	3635
„ New York State ..	3785
„ Mexico	3435
„ Italy	3565

Very heavy work like stone-cutting, or that of a soldier on active service, will need 4000 C. Two Scandi-

navian workers* obtained very interesting results by taking sample workers, generally two of a trade, and keeping their metabolism and diet under scientific observation for 24 hours at a time, while they carried on as far as possible their usual lives and avocations. From these results we see that stonemasons took 4100 to 4300 C. and sawyers still higher: painters, joiners and metal workers 3000 to 3500 C., and shoemakers and tailors 2800 C. or lower. But these numbers may very likely be rather lower than what the men actually *needed* for continuing their lives in full health.

The largest figures computed so far have been about

*Becker and Hamalainen, Helsingfors, Finland. (Skandinavisches Archiv für Physiologie, xxxi, 1914). (Taken from Fisher and Fisk; *How to Live*).

MEN:

Occupation.	Age.	Height.		Weight	During Rest.		During Work.	Total Calories per day 8 hours' work 16 hours' rest.
		ft.	ins.	lbs.	Calories per hour.	Calories per hour per lb. of body wt.	Calories per hour.	
Shoemaker	56	5	0	145	73	.50	172	2544
Shoemaker	30	5	8	143	87	.60	171	2760
Tailor	39	5	5	141	72	.50	124	2144
Tailor	46	5	10½	161	102	.63	135	2712
Bookbinder	19	6	0	150	87	.58	164	2704
Bookbinder	23	5	4½	143	85	.59	163	2664
Metal-worker	34	5	4	139	81	.58	216	3024
Metal-worker	27	5	5	130	99	.76	219	3386
Painter	25	5	11	154	104	.67	231	3512
Painter	27	5	8	147	111	.79	230	3616
Joiner	42	5	7	154	81	.50	204	2928
Joiner	24	5	5½	141	85	.60	244	3312
Stone-worker	57	5	11	156	90	.57	408	4104
Stone-worker	22	5	8	141	85	.60	366	4288
Sawyer	42	5	5	167	86	.50	501	5284
Sawyer	43	5	5	143	84	.59	451	4952

8000 C. for a Maine lumber-man's daily food, and 9000 C. for a rider in a bicycle race riding 16 hours in the day.

The following figures for ordinary forms of exertion may be interesting.

An average man consumes :—

In walking 3 miles in an hour along a level road	172 C.
In trotting 5.3 miles similarly	484 C.
Climbing a hill 1650ft. high, in addition to the effort of walking along the level..	407 C.
A bicycle rider going rapidly along the level—per hour	530 C.

During the last few years American experts in diet have tabulated the results of research in a new form which can be adapted to people of any weight, and, as we shall see in the next chapter, people of any age. This is done by estimating the number of Calories *per lb. weight per hour*, according to what the person is doing. Among various presentations of this kind, the schedules given by Mrs. M. S. Rose in *Feeding the Family* seem the most suitable for practical use. They are therefore reproduced here by permission.

1. *Men*	Requirements in Calories. per lb. per hour.	or in ordinary Fractions.
Man lying in bed	.5	$\frac{1}{2}$
,, sitting up	.6	$\frac{3}{5}$
,, standing	.75	$\frac{3}{4}$
,, walking or light exercise	1	1
,, at moderate exercise ..	1.25–1.5	$1\frac{1}{4}$–$1\frac{1}{2}$
,, at active exercise ..	1.75–2	$1\frac{3}{4}$–2
,, at severe exercise ..	3 or more	3

As an example, the daily requirements of a sedentary man weighing 154lbs. are thus calculated:

	Calories.
Sleeping, 8hrs. at .5 (or $\frac{1}{2}$)	616
Sitting, 8hrs. at .6 (or $\frac{3}{5}$)	739
Standing, 4hrs. at .75 (or $\frac{3}{4}$)	462
Walking, 4hrs. at 1	616
	2433

Requirements in protein. What is the quantity of protein required daily by the average man weighing 70 kilograms? It has been established by many experiments that the quantity is not directly influenced by the amount of muscular work performed. Therefore it would seem that a number could be quoted more readily than that for Calories. But the matter is beset with other difficulties, and has been far more in the region of controversy than has the consideration of total Calories. A few preliminary remarks will illustrate the difficulties.

1. The number to be determined is not the actual physiological minimum upon which life can be sustained, but what has been called the optimum, upon which the body will best perform its functions, keep each organ healthy and well developed, and be able to stand a sudden strain. Too large an allowance of protein throws great work on certain organs for its chemical transformation and elimination. Protein, as such, cannot be stored in the body for future use.

The optimum amount.

The main difference in the controversy as to high or low protein allowance turns to a large extent on the decision whether the common usage of mankind in temperate climates has led them naturally to the optimum,

or to some excess in protein which is gratifying to the appetite.

The digestibility of protein.

2. It should be clearly stated whether the quantity quoted as most suitable is the protein actually contained in food, or that actually digested. The digestibility of the various kinds differs (see p. 66 and p. 67). As a rule, the former is chosen and is, or should be, referred to as the " crude protein " allowance. In converting the protein from a mixed food into the digested quantity, 10 per cent. is often subtracted.

Method of estimating it only roughly approximate.

3. The method still adopted to calculate the percentage of protein in a given food is to estimate the percentage of nitrogen present, by analyses which have been made very close and accurate, and to multiply by a fixed factor to compute the protein. In this way small quantities of nitrogenous compounds which are not proteins are included. But, also, the proportion of nitrogen in a protein is not fixed ; it depends on what protein it is. Now that their chemical constitution is being determined by the study of the amino-acids which compose them, the percentage of nitrogen present can be calculated from their chemical formulæ, and is found to vary from about 15 to 19 ; whereas the fixed figure that has been taken is 16.

This point is important and needs careful statement and comprehension.

The protein content of a food is estimated by doing experiments to find the quantity of the element nitrogen present. The possibility that some of the nitrogen is not in a protein but in some other compound, is negligible in most cases, where the amount of any other

compound present is comparatively trifling. But the figure obtained for the percentage of nitrogen has been, by an established rule, multiplied by 6.25 to get the percentage of protein. This assumes that 100 parts of protein always contain 16 parts of nitrogen ($16 \times 6.25 = 100$). But the figure 16 is only an average, and not actually true for most proteins. Speaking generally the actual percentage is between 15 and $16\frac{1}{2}$ for animal proteins; between 16 and $19\frac{1}{2}$ for vegetable proteins. Then the factor for most animal proteins ought to be larger than 6.25; and for most vegetable proteins it ought to be smaller. There is no great need to classify the inaccuracy too rigidly in this way: the fact of an inaccuracy is much more important than proclaiming Animal to the right, Vegetable to the left, as if it was a Parliamentary division. Nevertheless it is certainly true that the smaller factor ought to be used for the proteins of cereals, and still more for those of nuts. But what kind of difference would this adjustment of the factor make? Something like 2 per cent. Of course this is not much. If a certain flour is given as containing 11.2 per cent. protein, the figure might be more accurate as 11. The chief moral to be drawn is to refrain from being at present confident about the exactitude of any of one's protein calculations (See also note to Table XIII).

First estimates of protein required.

As early as 1865 physiologists had begun the search for the right percentage of nitrogen for food; but the first definite statement of requirement in terms of protein was Voit's, published in 1881. This was based on the analyses of many actual diets of German working men, chiefly in Munich. His figure was 118 grams (about $4\frac{1}{2}$oz.) of

protein ; and represents what was actually taken, not what he considered necessary in theory. In 1896 Prof. Atwater fixed 125 grams as the result of his own researches in the United States ; and this figure was used by Rowntree in his report on working class conditions in York,* as the minimum daily allowance of protein for an average working man.

Low protein allowances. In 1904, Chittenden, another American physiologist, published his studies in diet, in which, as the result of many striking experiments, he concluded that efficiency could be maintained on as little as 50 or 60 grams of protein daily. At various times in the nineteenth century isolated experimenters in diet had tried to show by personal experience that a much lower protein diet was compatible with health. For instance, as early as 1829 an American named Sylvester Graham advocated a vegetarian diet of this kind, which produced, simultaneously with an admitted gradual loss of body weight, great increase in bodily health and appetite. (Graham also first introduced the use of a whole-meal flour, still known in the United States as Graham flour). The study of the diet of strong labouring men in tropical countries, notably of Chinese and Japanese coolies, led many observers to doubt the necessity of so much protein as is the custom in other countries ; it was also urged that the poorer labouring classes in these temperate countries certainly have not during the past centuries had anything like the amount accepted by the authorities. The American households studied by Atwater were certainly well fed ; he contended that this good feeding was necessary for well-

*B.S. Rowntree, *Poverty : A Study of Town Life*, 1900.

being. Voit, and still more Voit's followers, admitted that the consumption of meat in Munich, where most of his statistics were obtained, was beyond the average. They believed that a smaller quantity of protein might be found sufficient, and were not concerned to find that the German soldier's daily rations contained only 98 grams of protein. Voit considered excess in protein wasteful and unnecessary. Prof. Graham Lusk, who was his pupil, made this clear in the first edition of his *Science of Nutrition*, in 1906 ; and admitted that many vegetarians were apparently able to subsist with only 50 grams, although he was critical of Chittenden's general conclusions.

Meanwhile, Hindhede, a Danish physiologist, was following Chittenden's lead, and announced that 70 grams was quite enough, according to the results of many experiments on himself and on others, and even quoted in detail successful experiments in which the allowance of protein was hardly half that. His first results were published in 1906, but the chief part of his work was not translated into English until 1914. In 1906 Messrs. Hamill and Schryver investigated the nitrogen output of seven lecturers and students at University College, London, while they were having their usual diet and carrying on their usual occupations ; and found that the average amount of protein taken was 93 grams.

German experience.

The German scientific experts, investigating in 1915 the capacity of their nation to hold out under a food blockade, while making an admirable summary of all that was known about protein at the time, concluded that they need allow only 80 grams per adult man. But the disastrous events for them had

brought down their protein allowance, long before the end of the war, to something like 40 grams per adult per day. Prof. Starling, visiting Germany at the end of 1918, had to report that the large majority of the population were in a deplorable state of under-nutrition. The whole Calories per adult man were then only about 2000 ; the fats were 10 or at most 20 grams.*

These facts were likely to turn the scale against low protein diet, although it must be noticed that the advocates of this diet usually demand the normal number of Calories, if not more. But it is also true that our own war experience did not at all strongly support the high protein figures that used to be given. The Report on the Diet of Munition Workers (1918) gave as an average hostel dietary 90-100 grams Protein, in a diet ample enough to give 3856 Calories, for the heavy work involved ; and in war-time this caused no anxiety. But since then the emphasis in the discussion has been entirely shifted, as the work of distinguishing and classifying the separate proteins has gone on. They can now be placed, though somewhat tentatively, in order of desirability.

*German diet during the war, as calculated by various scientific authorities.

	Protein gr.	Fat gr.	Carbohydrate gr.	Calories
German soldier in peace time	120	50	500	3007
„ „ in 1917	100	67.5	460	2980
Heavy worker, 1917	54	32	336	2050
Very heavy worker, 1917	66	34	438	2400
Maximum worker, 1917	—	—	—	3500
Best civilian diet, 1917	55	28	322	1740
Official rations, 1917	38	13	300	1421
Actual in Dresden, 1917	33	9	140	1217
„ „ Hamburg, 1917	43	24	—	1650

Grading proteins. Prof. Lusk has suggested putting them in four grades; grade A, the best, being proteins of the kinds found in meat, milk, fish and eggs, which can replace body protein exactly; Grade D, the worst, definitely deficient proteins like that of gelatin (long since found unsatisfactory) or zein, one of the proteins in maize. Grades B and C are according to their percentage content of A and D better or worse proteins; thus wheat is Grade B, maize is Grade C. Prof. Starling gives the figures of an investigator in 1909 on the power of the protein in a given sort of food to prevent waste of tissue, milk being taken as 100.

Values of the protein present in certain foods.

Ox meat	104	Cherry juice	79
Cow's milk	100	Yeast ..	71
Fish ..	95	Casein ..	70
Rice ..	88	Nutrose ..	69
Cauliflower	84	Spinach ..	64
Crab-meat	79	Peas ..	56
Potatoes..	79	Wheat flour	40
		Cornmeal ..	30

These figures are reproduced here because of their great interest, and also because of the noticeable way in which animal and vegetable proteins are thoroughly mixed in order of preference; but their interpretation needs great caution. This is chiefly because the percentage of protein actually present in each food named differs so greatly, that the figures have really no quantitative value at all, but must be taken as an attempt to indicate *quality* in power of building body tissue. No confirmatory work on these lines seems to have been done since 1909. But the study of the disease of Pellagra

Pellagra. in various countries, notably in S. Carolina in 1916, and in Egypt (among prisoners) in 1918, seems likely to throw light on the quality of various proteins. It is established that pellagra is a deficiency disease due to under nutrition ; but that in this case the want of vitamines is probably not the most important influence, but a lack of some of the necessary amino-acids, which are not fully represented in the proteins of the diet. A further account of pellagra will be found in Dr. Harrow's *Vitamines.*

General conclusion. To return to general conclusions, notwithstanding our great interest in attempts to compare proteins in quality—we may really hold by the perverted proverb which came with an almost simultaneous outburst from our English scientific authorities in 1917 : " Take care of the Calories, and the protein will take care of itself." In other words if the average man gets 3000-3300 Calories in normal mixed diet he will get about 100 gr. mixed proteins which will be enough for him. Few authorities will give any larger figure, many would say 80 gr., particularly if the proteins were somewhat selected. Prof. Starling in his *Feeding of Nations,* the result of all his war-experience, is inclined to give 75 gr. as a quite feasible average amount, though not exactly recommended.

Protein and heavy-work. But what about the heavy worker ? Does he not want more protein ? It has been quite well established by diverse experiments that practically all the direct extra energy needed for heavy manual labour can be given by extra fat and extra carbohydrate, and as a matter of fact is so obtained. But there is nevertheless a consensus of opinion that for indirect reasons based in metabolism the quantity of protein

should be somewhat increased with the amount of manual labour. It must nevertheless not be forgotten that getting rid of extra protein throws some extra work on the body; and it is quite clear that in hot climates (see p. 74) or in hot weather less protein as well as less total Calories are needed.

Prof. Atwater had originally varied the quantity of protein with variation in manual labour thus:

	Proteins	Calories
Man weighing 70 kg. at *light* work	100	2700
,, ,, ,, medium ,,	125	3400
,, ,, ,, hard ,,	150	4150

Mr. Rowntree in his later work of 1918* is inclined to keep to 125 grams of protein for his "average man"; but it must be noticed that in his investigation of diets his "average" man is usually a man doing medium hard work,—a manual labourer; and that he would concur with a lower average for professional and sedentary occupations. Whereas he says that by tabulation of the meals taken at a West-end Club he found the average protein taken daily was 202 gr., the Calories 5148; a similar tabulation of working class family consumption in 1915, where he says the wages were "enough for the full satisfaction of appetite but not to encourage 'eating for the sake of eating' the average man's consumption was 115 gr., protein and 3790 Calories."

Fats and Carbohydrates.

It is natural to ask next, what is the proper proportion of fats and carbohydrates in the diet? These two forms of food are mutually replaceable, and therefore need not be discussed separately, as long as it is remembered that a given

**Human Needs of Labour.*

weight of fat produces a little more than twice as much energy as the same weight of carbohydrate. All three of the forms of food give energy; protein alone is available for tissue building. When enough protein has been supplied for this purpose either carbohydrates or fats may be taken to give the rest of the Calories for energy. The adjustment between the two is partly a matter of digestive power, partly of climate, and also very notably of cost. Carbohydrate food is cheaper than fat; and seems likely to remain so; the seeds we call cereals, which are the staple foods of the world, supply carbohydrate (starch) with protein, but little or no fat.

Economical diets, as in the poorer working class, generally contain an undesirably large proportion of starchy food, such as cereals and potatoes, and are not likely to have more than 50 to 70 grams fat ($1\frac{4}{5}$ to $2\frac{1}{2}$oz.). Most well-to-do people choose to have more fat; 4oz. is quite a common average. The power of digesting fat varies a good deal with the individual, as well as with the climate and his mode of life. The fats with lower melting points (such as olive oil) are more easily digested than those of higher melting point (such as mutton dripping.) Fat as a more concentrated form of heat-giving food is likely to be welcome in a cold climate or very cold weather, and unwelcome in a warm climate or weather. Speaking generally, 100 grams daily, or less than 4oz. is, however, as much as can be digested comfortably by an average person in a temperate climate. On the other hand, carbohydrates, though usually well digested, throw a good deal of work on the digestive system, and the amount per day should not exceed 18oz.*

*Apropos of digestibility it is well worth while to discuss the amount of sugar advisable in a diet. We have said that an econo-

Voit's original figures for complete diet gave with the 118 gr. protein 56 gr. fat and 500 gr. carbohydrates. (He did not express food values in Calories). The figures in oz. would be 2oz. fat and 18oz. carbohydrates with the 4½oz. protein.

The Royal Society Committee during the war took as a desirable diet for a healthy man of the average weight 100 gr. protein, 100 fat, 500 carbohydrate, which will give Calories 3380, if all the food is digested. The amount for a professional man might be reduced to 80 gr. protein and 2800 Calories.

It is very usual now to give merely the protein

mical diet consisting of some staple cereal food is apt to contain too much carbohydrate in the form of starch. But a diet where inclination has full play may overdo the suitable amount of sugar instead. Sugar as an ingredient in mixed food is extremely digestible; but food that consists chiefly of sugar is a very different thing. Of late years the Americans have been criticising their own diet somewhat unfavourably in this respect. A glance at the Table (p. 78) will show that as little as one ounce of sugar brings over 100 Calories; and half a pound of fancy chocolate will give a girl 800 or 900! Is this a satisfactory way of making up the day's quota of Calories? Physiologists tell us that a strong solution of sugar has a very bad effect on the lining of the stomach, and inhibits—in other words temporarily arrests—the process of digestion.

Thus the tradition that jam needs a good deal of bread with it is sound; and equally sound is the tradition that sweets in any quantity are bad for the digestive system. Whereas on paper the actual food value in Calories of jam and sweets looks very satisfactory, except indeed that they are without protein. Prof. Lusk found in an American boys' boarding-school that the average Calories taken by each boy was as many as 5000, of which 600 were in sweet stuff. The ordinary American ice-cream or sundae, now so much in demand in Great Britain, contains from 300 to 500 Calories according to size; and therefore is by no means a negligible part of the diet, if it is assimilated properly. But a diet in which so large a proportion of sugar accounts for the Calories needed is not a properly " mixed " diet in which (as we shall emphasise again later) all sorts of nutritious food should be represented.

Rates between protein and Calories.

present, and the Calories or total fuel value in a diet, unless there is any special reason to comment on the distribution of the Calories between fats and carbohydrates. If these two figures are given, the point of interest is what relation they should bear to each other. As generally given, the protein estimated in grams weight cannot be compared with the total in Calories; we must first express the grams of Protein in terms of the Calories they produce. It has become common of late years to analyse total fuel value into the Calorie contributions of the different kinds of food; and some of the later Tables will follow this plan, due to United States workers, of giving all the figures in Calories instead of percentages. This will be made as clear as possible in the right place. But the discussion of what *is* the right ratio—it used to be called the nutritive ratio—between protein Calories and total Calories must be mentioned. Nevertheless it is not now such a matter of serious controversy as it was ten years ago. It will perhaps sum up the situation briefly to say here that to take 15 per cent. of one's total Calories in protein is fairly high protein diet; $12\frac{1}{2}$ per cent. safe and average, 10 per cent. rather low, if the proteins are not carefully chosen.

CHAPTER IV

THE NUTRITIVE REQUIREMENTS OF WOMEN AND CHILDREN

During the last few years there has been a very distinct approach towards unanimity of opinion about the needs of women and children compared to those of men, so that there is now very little occasion to discuss rival opinions. This agreement has become possible through further knowledge and experience. The main thing that has been made clear is that the earlier physiologists were inclined to underrate the needs of children and adolescents.

In 1896 Atwater and Wood, in their *Dietary Studies in New York*, gave the following fractions, the diet of a normal man being taken as 1 :

A woman	.8
A boy 14-16	.8
A girl 14-16	.7
Child 10-13	.6
,, 6-9	.5
,, 2-5	.4
,, under 2	.3

They said this would probably need revision after further investigation. Ordinary experience certainly suggests that a boy over fourteen eats as much as a man ; a girl of fourteen as much as a woman. We have to

allow not only for growth and for greater body surface,* but (and this applies still more where the age is under fourteen) for the continual muscular activity of a child, which, it has been observed, seems to be stimulated by taking a meal, an effect quite the reverse of what we expect with adults.

The Inter-Allied Commission took

Woman	.83
Boy over 14	1.
Girl over 14	.83
Children 10-14	.83
,, 6-10	.70
,, under 6	.50

The general increase of the fractions is shown by the fact that Atwater took as the needs of an average person in the community, men, women and children all taken together, as .77 of a man ; whereas the Commission made it .835. But they wanted to be very much on the safe side.

Prof. Lusk gives practically the same table in a more convenient non-fractional form as :

If a man	needs 3000	Calories
A woman	,, 2500	,,
Boy of 14	,, 3000	,,
Girl of 14	,, 2500	,,
Children 10-14	,, 2500	,,
,, 6-10	,, 2100	,,
,, 0-6	,, 1500	,,

*An infant weighing 10lbs. is said to have a body surface of 3 sq. ft. A man weighing 200lbs. has a body surface of only 21 sq. ft., whereas the same proportion would give 60 sq. ft.

For the woman's allowance there is not much difference between the fractions .8 and .83; but much of course depends on the amount of manual labour which comes into the woman's life. The figures given by Becker and Hamalainen for women workers were obtained by the direct investigation of their diet and modes of life; as follows:—

WOMEN:

Occupation	Age	Height ft. in.	Weight lbs.	During Rest		During Work	Total Calories per day 8 hours work 16 hrs. rest
				Calories per hour	Calories per hr. per lb. of body wt.	Calories per hour	
Hand-sewer	53	5 3	139	75	.54	83	1864
Hand-sewer	35	5 6	143	64	.45	88	1728
Machine-sewer	53	5 3	139	75	.54	103	2024
Machine-sewer	19	5 3	110	64	.58	119	1976
Wash-woman	43	5 3	125	75	.60	285	3480
Wash-woman	19	5 3	110	64	.58	186	2572
Waitress	43	5 3	125	75	.60	228	3024
Waitress	19	5 3	110	64	.58	143	2168
Bookbinder	22	5 4	105	70	.65	98	1904
Bookbinder	22	5 3	112	61	.54	127	1992

Mrs. Rose is able to use the table quoted already for men (p. 30) for Calories per lb. of body weight for hour according to occupation. But she defines what kind of feminine work she would call "light," what "moderate" and what "active" exercise; and these definitions make her table worth repeating here.

	Calories per hour per lb. of body weight
A woman sleeping	.5
Sitting (reading, knitting, writing, sewing by hand or power machine)	.6
Standing	.75
Light Exercise (dish-washing, cooking for 2-4 persons, bed-making, sewing by foot power)	1
Moderate Exercise (cooking for 6-12 persons, sweeping, ironing scrubbing by hand)	1.25–1.5
Active Exercise (cooking for large groups, ironing, scrubbing with heavy implements ..	1.75–2

If the average woman's weight is taken as 123 lbs. (this is .8 of the 154 lbs. above), the Calories required by her daily, for moderate activity, will be :—

Sleeping 8 hours ..	492
Sitting 5 hours ..	369
Standing 2 hours ..	185
Light exercise 6 hours	738
Moderate 3 hours ..	461
	2245

According to these allowances, women will require Calories as follows, for specified occupations :

	Calories per woman per day according to weight
At rest	1600–1800
Sedentary work :	
Milliners, Teachers, Bookkeepers, Sempstresses, Stenographers, Machine operators	2000–2200
Occupations involving standing, walking, or manual labour :	
Occupations developing muscular strength :	
Laundresses, cooks for large groups	2500–3000

Children. The table following has been compiled from Mrs. Rose's suggestions for the diets of children at various ages. She calculates Calories per lb. weight ; but the height of a given child will also affect its needs, as the body surface depends somewhat on height. It will be noticed that the Calories per lb. are much greater at first than for adults. So is the protein ; which if measured in the same way for adults will be only 2 to $2\frac{1}{2}$ Calories per lb.

Children of Age	Calories per lb. body wt. per day	Calories in protein per lb.	Total Calories
1–2	45	4	900–1200
3–4	37–40	3–4	1100–1400
5–7	32–37	3–4	1400–1700
8–9	30–35	3–4	1700–2000
10–12	28–32	3–4	2000–2200
12–13	25–30	3	2200–2600 girls
14–17	20–25	3	2500–3000 boys.

Old people. Most authorities suggest a diminution in total Calories required after the age of 60. Mrs. Rose calculates only 1500 to 1800 Calories per day for people about 70, and still less for those over 80; and another authority gives the decimal .6 for people in receipt of old age pensions.

CHAPTER V

VITAMINES

EVERYBODY who is interested in diet is now familiar with the name vitamine, and presumably has some idea what a vitamine is. But, considering that the authorities who know most about the vitamines tell us that none of them has yet been isolated, and that but little is known about their chemical composition and the nature of their action, it is not surprising that misconceptions have arisen about them, some quite nonsensical. The subject is liable now to be exploited, both for advertisement and for propaganda purposes.

It therefore seems essential to a brief account of what is known about vitamines that one should begin by clearing away misconceptions, rather than by attempting to introduce them as a fresh subject. Anyone who wants full information about them should read one of the books or reports mentioned in our list, and, after that, take care to keep himself up to date by means of the scientific periodicals. It was said in 1923 that about one article a day was then appearing somewhere on the subject, and that about one-third of the whole literature concerned with it had appeared in the three years 1921-1923. Still, one may reasonably hope that this flood is not going on indefinitely, and that the actual nature of the substances and their exact influence on diet will soon be established.

At least three vitamines have been distinguished; they are usually called A, B, and C, and further distinguished as fat-soluble A, water-soluble B, and water-soluble C. The quantity of each substance which appears to be requisite to each human being for it to remain in health is exceedingly small, probably not as much as one millionth part of the weight of food eaten daily. Nevertheless the presence of these minute quantities does seem to be essential, for the negative reason that their absence means diminished health, gradually leading to disease. The vitamines are therefore called *accessory factors* to food; i.e. necessary additions. But note the word "factor," as intimating plainly that the idea is that a vitamine *does* something to food, or to the digestive apparatus, not that it *is* a food.

So far no experiment has indicated that life or health will be super-normal if the amount of one, or of more than one, vitamine is increased above the normal. We cannot use foods rich in these substances, it would seem, like Mr. Wells' "Food of the Gods," to produce either immense or rampageously active men, animals or plants. Therefore the only diet problem we are concerned with, practically, is to make sure that we get enough of each vitamine. And in a normal middle-class civilised diet we do always get enough. Monotonous or restricted diets, whether adopted for want of money, for eccentricity, from conviction or by some national necessity, are the only diets which run any risk of being poor in vitamines. It is, however, for children's diet that extra care and thorough investigation is necessary. They must have every possible assistance in achieving proper growth, and for that a supply of vitamines has been proved necessary. It is extremely

Safety in normal diet.

interesting to notice that tradition and custom have made very sound estimates of the kinds of food necessary to secure vitamines. The general prejudice in favour of green vegetables, raw and cooked; of fresh fruit, with good butter and eggs, has been given an entirely novel foundation. And the great value of cod-liver oil as a medicine for young folk has been so definitely proved as to promote every effort to make it palatable, or at least bearable, to them.

A good deal of the information we have about vitamines can be put in tabular form, convenient for reference. But these tables will not in this book be placed with the others, for a very plain reason, they are not numerical. At present indications of quantity are only in the form of less or more; and noughts and crosses are most frequently used to signify these indications.

1.—Fat Soluble A Vitamine

Necessary to growth and to normal health. Instrumental in curing rickets in children when these have developed by reason of deficient food. Present in animal fats except lard, but not in vegetable fats, except nut butters; in liver and kidney rather than in other lean meat, in eggs and milk (including dried milk), in the wheat germ, and in green vegetables, especially raw. The only fruit containing any notable quantity is the tomato. Not easily destroyed by heat, particularly if not exposed to air at the same time; because the change taking place under heat seems to be of the nature of oxidation and therefore to require the presence of air.

2.—Water Soluble B Vitamine

Necessary to growth and health. Instrumental in curing the paralytic disease beri-beri once common in the East, and proved to be due to a rice diet in which the rice grains have been "polished," i.e. all outer coverings of the grain removed. Present especially in eggs fresh and dried, milk fresh and dried, wheat germ, beans, peas and lentils, liver and kidney, nuts, yeast and yeast extract (such as Marmite) Behaviour under heat similar to that of fat-soluble A, but it seems to be the most stable of the three when heated.

3.—Water Soluble C Vitamine

Necessary to growth and health ; and to the cure of scurvy, which is almost certain to develop if this factor is absent from the diet.

Present specially in fresh lemon, lime and orange juice, in preserved lemon juice, in fresh cabbage and raw turnip juice, in cooked onions, in milk and in *germinating* peas and lentils. This vitamine is more easily destroyed by heat than the others ; and ordinary boiling, or heating gently for a long time, will very largely destroy the potency of most of the substances that contain it ; though a few such as orange juice and lemon juice are not so much altered as the others. The fact that tinned and dried vegetables are not able to keep off scurvy has been fully established in various Arctic expeditions.

War experiences and vitamines. A good deal of valuable experience about all these matters was gained during the War, and is being utilised in military and naval diet now, under expert advice. We shall only mention

here the instructive events in the siege of Kut in 1915-1916, in which the British and Indian components of the garrison had different food. The British were supplied with white flour and biscuits made from white flour, and tinned meat; they ate horse-flesh, however, as well as tinned meat. The Indians had a coarser barley flour and the tinned meat, but refused horseflesh. The Indians developed scurvy, the British did not. The former had no food to give them Vitamine C; the British had a little in their fresh meat.*

At the same time, while the Indians developed scurvy, the British developed beri-beri; and this was doubtless caused by the deficiencies in their white flour.

Other vitamines. Other vitamines may yet be isolated. It may prove that the rather conflicting evidence as to the effect of Fat soluble A, and also as to the special qualities of cod-liver oil, indicates the existence of another vitamine associated with A in that oil. And there is recent evidence to show that Vitamine B may have a Vitamine D in close association with it, and that their separate effects may in future be differentiated, one being that which prevents beri-beri, the other that which is necessary to growth.

But whereas the number of separate vitamines may be larger than three, a conviction is growing that they do not act separately, but that there may be some definite necessary balance amongst them, and some pro-

*An officer in the garrison has stated in the Medical Journal that the men were encouraged to collect any green leaves or herbs they could see (they were indeed few); and that some of these were selected and given out for use by a good botanist, who was with them. From later experiments, we know that if a besieged garrison can put peas or lentils to germinate, these would give the best available supply of Vitamine C.

portionate amount of each which is better than any other proportion.

Caution in statements.

The reader may be annoyed that it is so difficult to make quickly-remembered, sharply defined statements about vitamines at all. He may be sure that the more a physiologist knows about vitamines, the less he commits himself to statements of that kind. And do let him beware of the person who says "There! you see! No tinned food, no dried food" [or even, "no cooked food"] "is any good to you at all. It contains no nourishment. Nor does margarine." So they ride rough-shod through statements of the protein and fat content of tinned salmon, and the large fuel value of margarine, as if our whole desire for food was a chase for illusory vitamines; and meanwhile they mutter incantations which resemble the ancient riddle about the letter H:

> "'Tis absent from lard, but abounding in greens,
> 'Tis lost in the hay-box, but found in old beans."

The safest way is to have a Table to consult, and to try to keep that up to date by looking occasionally at some periodical such as *Physiological Abstracts* for later information. The best condensation of the main facts known at present may be given thus.*

Vitamine A occurs in green vegetables, and in the fat and milk of animals fed on green vegetables.

B occurs in eggs, meat and the husks (or outer skins) of cereals.

C occurs in fresh fruits and vegetables. And the

*See Starling, *Action of Alcohol on Man*. N.B. There might be added to the B list wheat germ, peas, beans and nuts; also yeast.

Good and bad diets. author goes on to say that a really bad diet would be white bread, vegetable margarine, tinned meat and dried vegetables.*

Vitamine preparations. Investigators have so far found it very difficult to concentrate vitamines; or, to speak more accurately, difficult to get any extract from an ordinary food which will contain a larger proportion of vitamine than the food itself. Until the nature and occurrence of the substances are known, this is bound to be the case. We must therefore beware of preparations advertised as being especially rich in vitamines. Ordinary butter and milk, yeast extract and cod-liver oil will as a rule contain in a teaspoonful as much of whatever vitamine is desired as any patent preparation at a much higher cost. The danger of course is that a particular preparation should actually contain little or none of any of the three. The only things that can recommend the best of them would be palatability or convenience.

*In 1918 the writer became acquainted with a very sturdy thriving family of country children whose staple food certainly was white bread and margarine, with potatoes and cheese; meat occasionally on Sundays. But there was a garden, and at every meal lettuces or boiled cabbage appeared, with the frequent addition of onions.

On the question of margarine the experience of Denmark is interesting. Before the war Denmark exported butter and used margarine for home consumption; during the war, materials for margarine could not be imported, and the nation while self-supporting was obliged to consume its own butter. Towards the end of the war an American observer commented on the superior nature of the Danish peasant's diet to the British country folk's, because of its including butter. But conditions in Denmark have now changed once more; and the poverty of their diet in Vitamine A now margarine has again replaced butter, is reported in a recent article to be causing deficiency disease there. It has been suggested that a small quantity of cod-liver oil—too little for the palate to detect—in the margarine would readjust matters!

The tests for these preparations are not easily undertaken ; the only method of procedure known at present is the same that must be used for testing all foods—to make careful experiments, lasting at least some weeks, in using them in place of substances known to contain vitamines, in the food of rats, guinea-pigs or other small animals. The results of such inquiries up till now have certainly not been favourable to the use of patent preparations.

Protective foods. A safe diet must contain what are now called " protective " foods, which are foods to be secured if one wants to minimise the risk of insufficient vitamines. The best protective foods are MILK and GREEN VEGETABLES.

Milk can be recommended as the best adjunct to any restricted diet. Fresh milk contains all the vitamines ; and a good dried milk is deficient only in Vitamine C, which can be supplied by orange juice or swede turnip juice.* It may be remarked here that the special weakness in milk for adults,—its liability to putrefy in the intestine—is much lessened by its being combined with a starchy food. It is also a little deficient in iron.

Green Vegetables seem the natural food to make up for any deficiencies in cereals, i.e. seeds. It has been proved by experiments in feeding stuffs that the most satisfactory food for herbivorous animals is the whole of a plant, or as much of it as can conveniently be represented. The value of vegetables as sources of Vitamines A and C is certainly higher when they are not cooked; but it is certainly not necessary to eat raw cabbage, carrot or turnip for this reason. The worst thing to do

*Milk which has been soured by careful lactic acid fermentation has been found to be successful as a source of Vitamine C.

with these vegetables, from this point of view is to use very slow gradual cooking ; but the moral to be drawn here is not that hay-box cooking should be given up, but that no one should have all the vegetables they eat cooked in hay-box fashion. Nevertheless, the juices of vegetables should always be conserved ; and some authorities, while favouring the quick cooking of vegetables, deprecate the use of soda.

The first table to be given is the one published by the British Medical Research Committee in 1920.

The Distribution of the Three Accessory Factors in the Commoner Food Stuffs.

	Fat-soluble A or anti-rachitic factor	Water-soluble B or anti-neuritic factor	Anti-scorbutic factor
Fats and Oils			
Butter	+ + +	0	
Cream	+ +	0	
Cod-liver oil *	+ + +	0	
Mutton-fat	+ +		
Beef-fat or suet †	+ +		
Pea-nut or arachis oil	+		
Lard ‡	0		
Olive-oil	0		
Cotton-seed oil	0		
Coco-nut oil	0		
Cocoa-butter	0		
Linseed oil	0		

*The oil extracted from most fish livers seems to contain A in notable quantity. It is stated that cod fish liver contains most, haddock liver least. The source of the vitamine is believed to be the marine diatoms and other unicellular plants which serve as food for the small molluscs and copepods upon which the fish feed.

†It is now considered that beef fat is somewhat superior in content of Vitamine A to either mutton or pork fat. In the case of pork, the fat round the kidney is distinctly better than the rest. Dripping also is stated to be a satisfactory source of the Vitamine. Probably beef dripping is meant.

‡The deficiency in lard has not yet been explained. It is prepared by heating in steam : but this process does not destroy Vitamine A in butter ; and it has just been stated that the melting of beef fat to form dripping is not destructive to it, either, at least not in any marked degree. On the other hand, while *Ghee*, the Hindu preparation of fat from cow's or buffalo's milk contains the vitamine experimenters have stated that the efficacy is lost on re-melting.

	Fat-soluble A or anti-rachitic factor	Water-soluble B or anti-neuritic factor	Anti-scorbutic factor
Fats and Oils (continued).			
Fish oil, whale oil	+ +		
Hardened fats, animal or vegetable	0		
Margarine from animal fat	in proportion to amount of animal fat		
Margarine from veg. fats or lard	0		
Nut butters	+		
Meat, Fish, etc.			
Lean meat (beef, mutton, etc.)	+	+	+
Liver	+ +	+ +	+
Kidneys	+ +	+	
Heart	+ +	+	
Brain	+	+ +	
Sweetbreads	+	+ +	
Fish (white)	0	very slight if any	
Fish fat (salmon, herring, etc.)	+ +	very slight if any	
Fish roe	+	+ +	
Tinned meats	?	very slight	0
Milk, Cheese, etc.			
Milk, cow's whole, raw	+ +	+	+
,, ,, skim, ,,	0	+	+
,, ,, dried whole	less than + +		less than +
,, ,, boiled ,,	undetermined	+	,, +
,, condensed sweetened	+	+	,, +
Cheese, whole milk	+	+	,, +
,, skim ,,	0		
Eggs, fresh	+ +	+ + +	? 0
,, dried	+ +	+ + +	? 0

	Fat-soluble A or anti-rachitic factor	Water-soluble B or anti-neuritic factor	Anti-scorbutic factor
Cereals, Pulses, etc.			
Wheat, maize, rice, whole grain	+	+	0
Wheat germ	+ +	+ + +	0
Wheat, maize, bran	0	+ +	0
White wheaten flour, pure cornflour, polished rice, etc.	0	0	0
Custard powders, egg substitutes prepared from cereal products	0	0	0
Linseed, millet	+ +	+ +	0
Dried peas, lentils		+ +	0
Pea-flour (kilned)		0	0
Soya-beans, haricot beans	+	+ +	0
Germinated pulses or cereals	+	+ +	+ +
Vegetables and Fruits			
Cabbage, fresh	+ +	+	+ + + +
,, ,, cooked		+	+
,, dried	+	+	very slight
,, canned			,,
Swede, raw expressed juice			+ + +
Lettuce*	+ +	+	
Spinach (dried)	+ +	+	
Carrots, fresh, raw	+	+	+
Carrots, dried	very slight		
Beetroot, raw expressed juice			less than +
Potatoes, raw	+	+	
,, cooked†			+

*Recent experiments have proved the existence of Vitamine B in asparagus, celery, dandelion and parsley.

†McCullum (*Newer Knowledge of Nutrition*) considers that the potato contains an appreciable quantity of Vitamine A in the layer just under the skin, where the chief part of the protein and of the mineral salts also exist. This would not be destroyed by boiling, but by peeling.

	Fat-soluble A or anti-rachitic factor	Water-soluble B or anti-neuritic factor	Anti-scorbutic factor
Vegetables and Fruits (continued).			
Beans fresh (scarlet runners) raw			+ +
Onions, cooked			+ at least
Lemon juice fresh			+ + +
„ „ preserved			+ +
Lime juice, fresh			+ +
„ „ preserved			very slight
Orange juice, fresh*			+ + +
Raspberries*			+ +
Apples			+
Bananas	+	+	very slight
Tomatoes (canned)*			+ +
Nuts	+	+ +	
Miscellaneous			
Yeast, dried		+ + +	
„ extract and autolysed	?	+ + +	0
Meat extract	0	0	0
Malt extract		+ in some specimens	
Beer		0	0
Honey		+	

*According to work recently published, orange juice appears to contain some Vitamine B, but no appreciable quantity of A. Tomatoes when fresh contain all three vitamines. Strawberries contain Vitamine C, quantity compared with that in raspberries not stated.

TABLE B. General Facts

From Prof. Harden's Article, "Vitamines and the Food Supply."—*Journal Society Chemical Industry*, April, 1921.

	VITAMINE OR ACCESSORY FOOD FACTORS		
	A	B	C
Synonyms	Fat Soluble A	Water soluble B Anti-neuritic	Water soluble C Anti-scorbutic
Effect of deficiency	Retarded growth ending in death Eye disease (keratomalacia) Probably one factor in causation of rickets	Retarded growth ending in death Beri-beri Polyneuritis in birds, rats, etc.	Scurvy
Chief sources	Animal fats Fish liver oil Green vegetables Egg yolk Butter and milk Oleo margarine in proportion to the animal fat	Seeds, particularly in the germ, pericarp and aleurone layers Yeast Egg Yolk	Green vegetables, particularly cruciferæ Orange juice Lemon juice Tomatoes Germinated seeds Swedes and turnips
Present in small amounts	Oilseeds Carrots	Meat Milk Potatoes and some other tubers and roots. Green vegetables Some fruit juices	Meat Milk Potatoes and some other tubers and roots Many fruit juices Dried vegetables
Absent from	Most vegetable oils Most lard Most margarine White Bread Egg white Yeast Purified proteins and carbohydrates	White bread Polished rice Fats Egg white Purified proteins and carbohydrates	Seeds White bread Fats Yeast Purified proteins and carbohydrates

TABLE C

From Report of British Medical Research Committee

Relative efficacy against Beri-Beri; presumed to indicate content of Vitamine B.

Wheat germ taken as	100
Wheat bran	25
Rice germ	200
Yeast (pressed)	60
Peas (dried)	40
Lentils	80
Egg-yolk	50
Ox-liver	50
Beef muscle	11
Potatoes	4.3

TABLE D

A table similar to the above for Vitamine C for the relative value of various foods, is given in an article by Dr. Harden on this vitamine in *Physiology and National Needs*, a collection of articles published in 1918.

Fresh cabbage taken as	100
Swede-juice (raw)	40
German lentils	20
Cooked cabbage	20
Runner beans	20
Boiled potato	5
Dried vegetables	1.6
Lemon juice	66
Orange ,,	33
Lime ,,	10-15
Grape ,,	5
Meat ,,	5
Cow's milk	1

TABLE E

This is from Mrs. Plimmer's *Vitamines and the Choice of Food,* and is an attempt to give actual quantities of certain foods required for what is called a "minimal ration" for an average man, to prevent scurvy. It applies therefore to the presence of Vitamine C only :

	oz.
Raw Cabbage	1
Lemon Juice	1.5
Orange Juice	1.5
Swede Juice	1.6
Preserved Lemon Juice Germinated Lentils Peas Cooked Cabbage Runner Beans (pods)	3.3
Fresh Lime Juice	6.6
Carrot Juice Apple „ Grape „ Bananas Potato Raw Meat Juice	13.3

CHAPTER VI

THE BROWN BREAD CONTROVERSY

"There is no nourishment in white bread."

Whereas, see Table II and Table A.

	Protein per cent.	Fat per cent.	Carbo-hydrate per cent.	Calories per lb.
White bread ..	7.0	1.0	47.4	1046

100 Calories in White Bread—one slice $6'' \times 3\frac{1}{2}'' \times \frac{1}{2}''$

Nevertheless the preposterous statement above is to be heard at present quite often. A brief resumé of what is known about various kinds of bread may therefore be useful; though we may be sure that so nonsensical an assertion must soon die a natural death.

Different milling processes.

There is a demand for a return to stone-milled flour, instead of roller-milled flour, as the former is not a white flour and is considered more nutritious simply for that reason. But it is curious that the stone-milling process, as originally used on English wheat, produced a whiter flour than had been known before, because it separated the husk from the English grain quite successfully; and this husk was removed after the grinding by the process of bolting or sifting. When Great Britain began to import the harder grains of the western hemisphere the husk was not separated as completely, even after sifting; and the flour lost its white colour, from containing a little pow-

dered husk. The Hungarian roller mill process was invented to get white flour once again. This process succeeded also in getting rid of the wheat germ, which is the small embryo or young plant. This was considered an advantage over the stone grinding process, because the germ contains a little fat which is apt to go rancid; and flour which is without it always keeps better.

White and dark bread eaters.

During the development of civilised life in Europe white bread was coveted as a luxury belonging to delicate eating, while the common people had bread made of unbolted flour. The white bread was always made of wheat; the dark bread might be chiefly rye or barley. Great Britain was one of the foremost nations in supplying her poorer folk with a wheat bread, that was white; and the same has been the case in the United States.

Town bread unsatisfactory.

In the congestion of our cities, the immense demand for bread has certainly of late produced very badly made bread, faulty in many ways and made under faulty conditions. Dissatisfaction with its tendency to sourness and dryness, its questionable cleanliness, and the risk of adulterants, has caused great variety of demands. Some people want "home-made" bread (a very vague expression); others on the contrary want bread made by machinery and untouched by hand; some want bread aerated by some other method than yeast, others are convinced that brick ovens are necessary. A last natural demand is for "old-fashioned" flour. Poorer folk have generally demanded white bread, perhaps unconsciously still resenting its consumption having been a class distinction; and there has been even a demand for obviously unnatural very white flour which can be obtained

only by some bleaching process; as the gluten in flour must give it a slightly yellow tinge. Brown bread proper contains more or less bran or husk. The rough taste and texture of this are very palatable to some people, irritating to others.

Brown bread.

But there is always a brown tinge in flour which retains the germ; so that wholemeal flour, containing all the germ of the grain ground up with it, and the innermost skin of the husk, has a grey or brown tinge. Further, a new process has been introduced to make bread more palatable and digestible; some malt is added during the rising of the bread, which converts some of the starch into sugar and into dextrine, making it soluble. (See p. 4). In this process a brown tinge also is produced; so that "brown bread" is now a very vague term.

Content of protein.

Analysis has shown that bran contains rather more protein per cent. than the starchy endosperm which is the main part of the grain. It contains more mineral matter also. But bran consists very largely of cellulose, which is not only indigestible itself, but interferes with the assimilation of the protein and of the minerals. So that it was contended that it was really better to feed animals with this bran which they could fully digest, rather than keep any noticeable portion of it in flour for human consumption. Again, the amount of protein in one specimen of white flour might actually exceed the amount in a specimen of wholemeal or of unbolted flour, if they were made from different grains.

On the other hand the protein of the germ occupies a large portion of it, and it is as digestible as that in the rest of the grain. But quite apart from digestibility,

it is very necessary to study carefully the general composition of a wheat grain in detail. The following figures have been calculated by the American workers Osborne and Mendel from samples of American wheat. The whole wheat grain is 15 per cent. husk or bran, 83.5 per cent. endosperm and 1.5 per cent. embryo or germ.

The germ therefore is little more than $\frac{1}{70}$ of the whole. About 18.7 per cent. of the bran is protein; about 36.7 (more than one-third) of the germ is protein; only 11.1 per cent. of the endosperm is protein.

But the protein of the whole grain is thus distributed; 22.3 per cent. in the bran, 73.3 per cent. in endosperm and 4.4 per cent. in germ.

To get the whole of this protein you would have to consume all the husk or bran; and between one-fifth and one-fourth of it would be less digestible than the remaining part. The bran might be a useful stimulant to the intestinal action, or to some people it might be an irritant. It ought to be added that experiments during the war showed that the coarse bread which had to be used then, with very little sifting, was much better digested by an average person than had previously been believed. During some periods of the war we were eating 86 per cent. and even 90 per cent. flour (i.e. bran removed to the extent of 14 or 10 per cent only. Wholemeal flour is about 80 per cent., white about 72 per cent. of the grain.

New arguments for brown bread

The last decade of scientific work has revealed further facts about both the husk and the germ of wheat which certainly increase their value for human consumption. When proteins are differentiated in composition and value it

is found that the proteins in the germ and also in the husk are different from those of the endosperm, and on the whole more valuable. And, also, as we saw in the last chapter, Vitamine B occurs in the germ (with a little Vitamine A) and also in the husk, but not in the endosperm. These facts must be put together, because when information is sought by making experiments in diet it has become rather difficult to disentangle these separate aspects of the value of the grain. As early as 1911 it was reported that rats fed on white flour alone died, while rats fed on wholemeal flour thrived ; and the same seemed to be true, as far as the evidence went, of wholemeal and white bread.* But was this due to deficiency in the right proteins or to deficiency in vitamines ? Other experimenters† shortly afterwards showed that pigeons becoming weak and contracting polyneuritis on white bread were restored by yeast, which would provide Vitamine B (also the one now surmised, Vitamine D), but no fresh proteins. Osborne, however, has made recent analyses which have identified the proteins in the germ and in bran, and have shown that they do supply deficiencies in the proteins (glutenin and gliadin) of the endosperm. His conclusion is, not that wholemeal bread is necessary in our diet, but that the protein deficiency on white bread *can* be supplied by the other parts of the wheat grain, but is just as well supplied, and by smaller quantities, of various other articles in a mixed diet, such as meat or milk. The same thing is true about the vitamine ; in an ordinary diet we do not depend on our bread for Vitamine B. It seems doubtful indeed that the small quantity of yeast put into white bread is

* Hill and Flack, *British Medical Journal*, May-June, 1911.
† Edie and Simpson, *ibid.*, 1911.

enough to supply it, even though this vitamine withstands heat best of the three ; but we need not look to the yeast to supply it, if we are eating eggs, peas and beans or even meat.

Summary. It is now possible to sum up all these considerations. Readers are asked to refer also to the Table of Breads from the last edition of Hutchinson's *Food and Dietetics*, given in an abbreviated form on p. 102.

Artificially White Bread (made from bleached flour). A taste for this may be called depraved. For though the harm done by bleaching and the use of " improvers " is greatly exaggerated, there is no conceivable good done by the process.

Ordinary White Bread from roller-milled flour. There is no objection to this as part of a normal diet. It will not form a satisfactory diet by itself ; nor will it with butter, still less with margarine.

Wholemeal Bread from stone-milled flour. This will usually, though not certainly, contain a little more protein than white ; and some Vitamine B. The germ in it forms a very small proportion of the whole,* and the improvement on white bread will be slight. But if a diet has to be nearly all bread, wholemeal will be preferable. If it must be made by stone-milling, its use can hardly become universal among the world's wheat-bread eaters, as this process has been so much superseded by the other.†

* See above. The protein in the germ is $\frac{1}{7}\frac{1}{6}$ of the whole grain.

† When peasants have had this sort of bread, it usually has been their chief article of diet, in hard times, and in that case their survival on this food would not have been achieved had the bread been white. But we can no longer contemplate without concern and repudiation the prospect of a working class subsisting on bread and little else.

Brown Bread proper, containing more bran than the preceding one and made from almost or quite unsifted flour. This is little or nothing superior to wholemeal, and to consume it is greatly a matter of taste ; it is not necessary for anyone. We all put up with it during the war, and almost all of us gave it up as soon as possible, not having learned to appreciate it.*

Brown Bread containing an extra quantity of germ. It is possible to obtain in quantity the separated germs removed from the wheat grains in roller milling ; and these can now be treated so as to render them much less liable to turn rancid (through the action of superheated steam). It would be possible to restore them in the original proportion to white flour, and thus, by a fresh process produce wholemeal bread, which might be more appreciated. But what happens now is that " Germ Breads " are made, containing the germ in very much larger proportion. This is the case with " Hovis," for instance. The result is a brown, rather moist loaf, with a flavour generally liked, and an unusually high proportion of protein (see analysis) ; probably also richer than most breads in Vitamine B (as may be shown if diet experiments on animals are tried with it.) The cost of bread of this kind is generally a little higher than that of ordinary bread. At present it is not difficult to obtain the extracted germ, because of the very large amount of white flour manufactured. Probably there would always be a certain amount of white flour made for pastry and cakes, and therefore always some amount of germ to get rid of ; but if the present demand for white bread were appreciably diminished, these germ

* Of course, the bread was often burdened with other, more trying, ingredients then.

breads would become quite expensive luxuries. And it is obvious they cannot be recommended for universal consumption. For it appears that the germ-bread consumers are supplied with their fancy in bread mainly by the white bread consumers, who must therefore be encouraged, not discouraged !

Finally *Brown Bread containing malted starch.* Some of these patent breads contain extra germ also ; but, if the treatment with malt to act on the starch is the only process rendering the otherwise white bread brown, there is no increase in protein or in Vitamine B ; but a rather moist, slightly sweet and digestible bread which keeps very well, and is agreeable to many palates. This bread also will usually be more expensive than ordinary bread. See the list on p. 102.

CHAPTER VIII

TABLES

TABLE I

GENERAL STATEMENTS OF DIETARY REQUIREMENTS

A.—**A man weighing 70 kilograms, or 154 lbs., needs per day :—**

FOR	Calories	Protein in grs.	Protein in ozs.	Protein in Calories	Per cent. of Total Calories
An average life with some manual labour	3300	100	$3\frac{1}{2}$	410	12.5
A sedentary life ..	2800	80	3	328	12
Harder manual labour	3600	125	$4\frac{3}{8}$	572	14.25
Heavy „ „	4000 and upwards	140–150	$5–5\frac{1}{4}$	575 to 615	14.5 to 15.5

These are round numbers ; and also indicate crude calories, and crude protein, not all of which is digested. Similar numbers for a woman weighing about 123 lbs. will be :—

	Calories	Protein in grs.	Protein in ozs.	Protein in Calories	Per cent. of Total Calories
Sedentary life ..	2250	64	$2\frac{1}{2}$	270	12
With manual work	2500	73	$2\frac{3}{4}$	300	12
Harder work ..	3000 –3300	90–110	$3\frac{1}{4}–3\frac{3}{4}$	370 –420	12.3 –14

For detailed figures for children, refer to page 47.

B.—**For calculations of the Needs of a Nation or City, according to the Inter-Allied Commission, 1918 :—**

Each man	needs	3000 Calories
„ woman	„	2500 „
Child 0-6	„	1500 „
„ 6-10	„	2100 „
„ 10-14	„	2500 „
Girls over 14	„	2500 „
Boys „ „	„	3000 „

C.—**Division of diet into the three categories.***

		Protein	Fat	Carbo-hydrates	Calories
Voit, from statistics in Munich, for working men	gr.	118	56	500	3055
	oz.	4¼	2	18	
When more money can be spent—probably ..	gr.	118	80	400	2900
	oz.	4¼	3	14	
Suggested for the "average life" above	gr.	100	90	500	3300
	oz.	3½	3¼	18	

* The distribution at a single meal has been much discussed under the heading of " balanced meals." Some very instructive examples are discussed in the Government investigation in 1918 into munition workers' meals (see Book List). A man worker needs about 1000 Calories at a substantial meal; women and sedentary people 700 or 800. Three such meals leave a small margin for tea. The restaurant at an American girls' school prints against each diet the number of Calories in a helping, and the general direction that about 800 will be enough for a proper meal.

Speaking generally gross feeding means too large an amount of fat, in pork of all kinds, rich pastry, cream, etc.; and is not likely to be a common mistake while fats are expensive. Where cost is the first consideration, carbohydrates are likely to show preponderance. During the meat shortage of 1917-18 many people who had recourse to vegetarian dishes were apt to overdo

Paying too exclusive attention to Calories only would lead us to the error of choosing fats as the most concentrated form of feeding, or to the equally great error of choosing sugar in some form as good fuel value, free from impurity, and very agreeable to take. Neither would give protein ; and both, especially the first, would put strain on the digestion.

The influence of climate on the balance among the different varieties of food may be seen from the following :

Daily Diet of	Weight	Protein	Total Calories	Calories percentage		
				Protein	Fat	Cal'ries
	lbs.	ozs.				
Eskimo	65	282	2604	44	48	8
Bengali	50	52	2390	9	10	81
European	70	118	3055	16	17	67

Table D for Mineral Salts :

Food may be arranged in the following order according to the contribution of minerals generally :—

1. Pulses and cereals.
2. Vegetables.
3. Meat.
4. Fruit, including nuts.

Iron.

The following list was given by Bunge according to the contribution of iron :—

Spinach (and other green vegetables).
Yolk of egg.
Beef
Apples
Lentils, beans, peas.

their carbohydrate consumption, from not realising that their meat-substitute was not usually a substance containing only protein and fat, like meat. A made dish of macaroni cheese supplies plenty of carbohydrate in the macaroni, and it is quite unnecessary to order a good helping of potatoes and a roll to accompany it, as if it were a slice of meat. One American writer lays it down as a maxim that potatoes, macaroni and rice should never appear at the same meal.

Strawberries.
White of Egg.
Wheat.
Potato.
Milk.

Cheese and butter are also deficient in iron; oatmeal, rice and maize contain more than wheat.

Calcium. Milk, eggs, cereals and vegetables supply this; meat, fish, potatoes, fruit are deficient.

	Animal foods in Order.	Vegetable foods in Order.
Phosphorus.	Cheese (certain sorts)	Haricot beans.
	Mutton.	Barley.
	Cheese (other sorts).	Chestnuts.
	Eggs.	Potatoes.
	Beef.	Cabbage.
	Milk.	Turnips.
	Pork.	Carrot.

Salt. About 15gr. ($\frac{1}{2}$oz.) is excreted daily. This should therefore be a sufficient daily amount.

Requirements of the Body in Water.

About two-thirds of the weight of the body consists of water. From 4 to 4$\frac{1}{2}$ pints are excreted by an average man daily. This quantity should therefore be taken in the diet. Ordinary solid food contains from 1 to 1$\frac{1}{2}$ pints.

Therefore a quantity between 2 and 3 pints should be drunk as liquid.

Requirements of the Body in Mineral Salts.*

A body weighing 154 lb. contains about 8 lb. 12 oz. of mineral matter. In this there is estimated to be :

	lb.	oz.
Calcium phosphate } „ carbonate }	1	.08
Magnesium phosphate		7.0
Sodium sulphate, phosphate and carbonate ..		2.2
Potassium sulphate, phosphate and carbonate		1.7
Silica		.1

and iron, iodine and fluorine in smaller quantity.

The facts can now be put in another way. In the very numerous and varied experiments now constantly carried on in artificial diet, it is necessary to supply a suitable mixture of mineral salts to satisfy the animal's requirements. The following is quoted by Harrow in *Vitamines* as the most successful :

	grams		grams
Calcium carbonate ..	134.8	Manganese sulphate	0.079
Magnesium „	24.2	Sulphuric acid ..	9.2
Sodium „	34.2	Citric acid ..	111.1
Potassium iodide ..	0.02	Ferric citrate ..	6.34
„ carbonate	141.3	Sodium fluoride	0.248
Phosphoric acid ..	103.2	Pot. Aluminum sulphate ..	0.0245
Hydrochloric acid ..	53.4		

* Tibbles, *Foods, their Origin, etc.*

TABLE II

GENERAL TABLE FOR FOOD VALUES OF FOOD AS PURCHASED

To be used in calculating the amount of protein and other food material in a weekly or daily diet, from the household accounts.

As many as possible of Plimmer's figures are used here, in accordance with what was said in the Preface.

	Percentages			Calories per lb.	Source
	Protein	Fat	Carbo-hydrates		
Average—Beef, Veal, Mutton	15.2	19.0	—	1087	
Beef—Average ..	14.7	19.5	—	1096	P
Best Cuts ..	21.2	9.0	—	774	P
Shank (hock or shin) ..	23.1	4.8	—	627	P
Mutton—av. of leg, shoulder, neck	13.0	32.7	—	1622	P
Veal	17.9	5.0	—	544	P
Pork	14.9	24.5	—	1310	P
Ham	11.5	41.0	—	1944	P
Bacon—side (without skin) ..	9.1	52.6	—	2388	P
Sausages (Pork) ..	11.2	17.7	15.2	1238	P
,, (German)	18.5	16.7	8.3	1085	Lusk
Fish, (general av. of) non-fat ..	13.6	1.2	—	292	P (av.)
,, Fat (as Herring and Mackerel	15.0	7.0	—	615	P (av.)
Salmon	16.3	12.9	—	847	P
Tinned Salmon	21.2	11.5	—	915	Lusk
Lobster or Crab ..	21.0	0.2	1.5	430	P (mean
Herring (salt) ..	16.1	9.5	—	715	P
,, (smoked)	15.6	14.4	—	898	P
Haddock ,, ..	14.9	—	—	286	P
Sardines ..	24.0	12.1	—	930	Sherman

	Percentages			Calories per lb.	Source
	Protein	Fat	Carbo-hydrates		
Eggs (Hen's with shell) ..	11.1	10.1	—	82 per egg	P
Dried Eggs (mean)	40.3	39.6	—	2598	P
Milk	3.3	3.6	4.8	378 pt.	P
,, (Skim) ..	4.0	0.7	4.6	192 pt.	Tibbles
Buttermilk (variable)	2.7	0.4	4.3	192 pt.	Hutchison
Milk (condensed unsweetened) ..	10.6	10.8	14.1	848	Tibbles
,, (cond. swtnd.)	10.5	9.9	57.5	1600	,,
,, Dried (mean of two) ..	24.5	24.2	35.1	2126	P
,, Skim ..	26.5	12.0	45.0	1838	Tibbles
Butter	0.2	83	—	3503	P
Margarine ..	0.2	84.8	—	3579	P
Lard	—	100	—	4219	P
Suet	1.2	93.3	—	3958	P
Dripping	—	100	—	4219	P
Cheese	25.7	35.0	3.1	2011	P
Flour	10.1	1.6	75.5	1660	P
Bread	7.0	1.0	47.4	1046	Average
Biscuit (plain) ..	8.0	8.8	70	1888	P
Macaroni ..	11.7	0.2	76.8	1656	P
Rice (unpolished) ..	6.8	0.6	80	1640	P
Barley (pearl) ..	7.0	0.8	79.9	1655	P
Sago	0.2	—	87.7	1636	P
Tapioca	0.2	—	87.7	1638	P
Cornflour	0.8	0.1	87.6	1648	P
Semolina	11.4	1.1	75.3	1659	P
Oatmeal	11.9	8.6	70.0	1886	P
Sugar (white ..	—	—	100	1860	P
,, (brown) ..	—	—	98	1823	P
Syrup (golden) ..	0.3	—	76.4	1427	P
Jam	0.3	—	76.4	1296	P
Dried Fruits, average of currants and raisins ..	1.9	0.3	56.0	1090	
Pulses (dry)					
Beans ..	17.8	0.5	64.5	1545	P
Lentils ..	20.1	0.4	63.9	1579	P
Peas	20.3	0.7	63.0	1467	P
Tinned Pork and Beans ..	8.0	21.5	4.8	751	P

	Percentages			Calories per lb.	Source
	Protein	Fat	Carbo-hydrates		
Nuts	16.5	56.9	13.6	2960	P
Potatoes	1.8	—	18.8	386	P
Onions	1.3	0.1	10.3	219	P
Carrots	1.3	0.1	9.6	205	P
Green Vegetables (mean) ..	1.4	0.1	6.3	149	P
,, Salads (mean)	1.3	0.2	2.4	78	P
Tomatoes	0.7	0.1	4.5	101	P
Bananas	0.6	0.1	14.1	279	P
Fruit (av. fresh)* ..	0.4	0.1	7.8	161	P
Cocoa	18.1	26.8	40.3	2215	P
Chocolate	4.8	31.1	59.9	2515	P

* Apples, pears, plums, oranges.

FULLER TABLES OF ANALYSES.

Meat.

Two sets of figures are really wanted by the housekeeper; one giving the composition of joints as purchased, and the other the composition of the portions of meat as finally dispensed at table. In considering the latter set, it has now been generally recognised that during preparation, cooking and carving, a large proportion of fat is separated from meat, and some people continue that process on their plates. Thus if the food value of a slice of meat is taken from that of a joint, the fat (and therefore the total Calories) will be quoted too high. Dr. Plimmer has therefore given analyses for lean meat, which will be most suitable for estimating the food value of single meals, and some analyses of cooked foods have been added here. If any individual at a meal asks for and consumes a good slice of fat, the value of this by itself may be roughly computed; taking about 80 per cent. of the estimated weight as fat, about 5 as protein.

But for the first set the housekeeper wants bone and other waste, besides the fat and protein. For price is an important consideration in her calculations. It is therefore rather unfortunate for her purpose that in Dr. Plimmer's Tables, now to be given, the actual percentage of bone in a joint is not given, except for pork and for veal. The analyses were made, for army purposes, of typical *sections* of each joint. The sections in the case of beef were taken without bone; those for mutton and lamb contained some amount of bone. For beef an average allowance for the whole animal of 15-20 per cent. was made; for mutton and lamb 15 per cent.

In the circumstances it is thought advisable to sub-

join to Plimmer's figures in Table IV, the American figures of Table V, which appeared in the former editions. These give the refuse for each joint. The figures for protein, fat and Calories will generally be lower in Table V than in Table IV, as the pound weight in the latter contains no bone.

TABLE IV

Meat from Plimmer's Analyses

Beef (without bone)

	Water	Protein	Fat	Calories per lb.
Brisket (whole)	41.4	13.8	42.8	2064
,, (lean)	69.5	20.4	8.2	725
Fillet (whole)	47.8	14.9	36.3	1809
,, (lean)	65.4	20.4	12.8	919
Rump steak (whole)	43.9	13.7	41.5	2006
,, (lean)	69.2	21.9	7.3	715
Silverside (whole)	63.4	20.9	15.3	1016
,, (lean)	71.6	22.1	4.9	618
Sirloin (whole)	52.0	16.6	21.1	1618
,, (lean)	66.9	21.5	10.1	826
Shin	70.2	23.1	4.8	632
Topside (whole)	49.6	15.8	33.7	1715
,, (lean)	71.5	22.5	4.6	612
Fore rib (whole)	53.2	16.4	28.6	1511
,, (lean)	68.0	20.0	9.9	790
Middle rib (whole)	63.0	20.0	16.5	1068
Beef Offal				
Heart (whole)	44.5	13.16	40.8	1974
,, (lean)	75.2	19.7	2.9	505
Cheek (lean)	73.0	20.4	5.5	611
Kidney	76.3	18.1	2.6	446
Liver*	70.8	19.9	3.2	587
Tripe	81.3	15.7	2.1	382
Tongue (whole)	46.8	11.9	38.6	1851
Tail (bone 29.4)	36.7	15.4	25.1	1344

* Of the carbohydrate Glycogen 14.4 per cent. (by difference)

Veal

The fat and lean are not separated in these analyses; bone is included, and they are not made by sections.

	Bone	Water	Protein	Fat	Calories
Forequarter	16.1	62.4	16.4	3.4	451
Hindquarter	2.8	71.4	19.6	3.6	515
Loin	12.5	58.1	17.2	11.6	812
Head	46.9	40.6	8.4	4.0	326
Liver*	—	72.6	14.6	0.9	505
Sweetbread	—	75.7	20.5	1.8	457
Tripe	—	81.3	15.7	2.1	381

* Of the carbohydrate Glycogen 10.5 per cent. (by difference).

Mutton

Analyses of sections, similar to those for beef, but with the bone as it occurred in the section.

	Bone	Water	Protein	Fat	Calories per lb.
Breast (whole)	11.2	30.3	10.8	47.1	2187
Leg (whole)	3.1	51.7	16.1	28.5	1501
,, (lean)	—	70.8	21.1	7.0	688
Loin (whole)	5.5	27.8	9.5	56.6	2562
,, (lean)	—	65.8	21.6	11.8	899
Neck (whole)	22.1	29.0	9.5	34.9	1648
,, (lean)	—	54.2	17.4	25.6	1403
Shoulder (whole) ..	5.4	45.2	13.2	34.9	1719
,, (lean) ..	—	69.4	19.5	9.6	767
Head (whole)	53.9	26.8	7.1	11.4	613
Kidney	—	75.8	17.1	3.5	466
Tongue	—	57.3	12.4	27.5	1391
Liver†	—	71.3	21.5	3.0	593

† Of the carbohydrate Glycogen 2.5 (by difference).

Lamb

Analyses of sections similar to those of Mutton.

	Bone	Water	Protein	Fat	Calories per lb.
Breast (whole)	4.4	30.7	12.0	51.7	2404
Leg (whole	1.9	58.6	17.2	4.6	1192
,, (lean)	—	71.7	20.5	5.9	630
Loin (whole)	8.1	45.8	13.5	—	1569
,, (lean)	—	71.6	20.6	5.5	615
Neck (whole)	14.1	31.2	10.4	43.4	2022
,, (lean)	—	61.7	19.7	16.7	1071
Shoulder (whole) ..	3.0	49.8	13.4	32.3	1611
,, (lean) ..	—	70.3	18.7	8.7	715

Pork

	Bone	Water	Protein	Fat	Calories per lb.
Belly (whole)	13.9	36.7	13.9	31.4	1585
,, (lean)	—	66.0	20.1	12.5	901
Leg (whole)	15.8	50.5	16.3	11.9	1262
,, (lean)	—	73.8	19.3	6.0	612
Loin (whole)	16	35.0	12.9	32.6	1616
,, (lean)	—	66.0	21.4	11.1	866
Shoulder (whole) ..	12.8	37.7	15.4	27.0	1427
,, (lean) ..	—	63.3	19.7	15.9	1037
Head	—	33.5	14.1	27.0	1400
Tongue	—	67.1	16.5	15.2	948
Trotter	44.5		14	11.0	723
Kidney	—	76.6	17.2	3.2	455
Liver*	—	69.9	17.1	2.7	590
Blood†	—	85.9	12.9	—	240
Heart	—	75.1	16.2	6.4	592

* 8.5 per cent. Glycogen (by difference).

† This analysis of pig's blood is given by Plimmer because that ingredient is used in the sausages known as black-puddings. Hutchison also gives, in answer to questions he has received, this average analysis of blood.

Water 80.8 ; N x 6.25=18.1 ; Fat 0.2

and adds that he does not consider blood itself a food, and that the nitrogenous constituent is chiefly hæmoglobin, which ought not to count as a food protein, not being well digested. It should be considered as " a carrier of food, rather than food."

TABLE V

Meat*

	Refuse	Water	Protein	Fat	Ash	Calories per lb.
Beef						
Brisket ..	23.3	41.6	12	22.3	0.6	1165
Flank	5.5	56.1	18.6	19.9	0.8	1185
Loin (whole) ..	13.3	52.9	16.4	16.9	0.9	1020
Steak (porter-house)	12.7	52.4	19.1	17.9	0.8	1110
Ribs	20.1	45.3	14.4	20	0.7	1110
Round (best) ..	8.5	62.5	19.2	9.2	1	745
„ (2nd cut)..	19.5	56.2	16.4	6.9	0.9	595
Rump	19	46.9	15.2	18.6	0.8	1065
Shank (fore) or shin	38.3	43.2	13.2	5.2	0.6	465
Shank (hind) or hock	55.4	31	9.7	3.9	0.4	345
Beef Organs						
Ox Heart ..	5.9	53.2	14.8	24.7	0.9	1320
„ Kidney ..	19.9	63.1	13.7	1.9	1	335
„ Liver ..	7.3	65.6	20.1	3.1†	1.3	555
„ Tongue ..	26.5	51.8	14.1	6.7	0.8	545
Tripe	—	?	14.1	3.1	—	392
Salt Beef						
Brisket	21.4	40	14.4	19.4	4.5	1085
Rump	6.0	54.5	14.3	22	3.1	1195
Veal						
Breast	24.5	51.3	15.3	8.6	0.8	645
Cutlets	3.4	68.3	20.1	7.5	1	690
Leg	11.7	63.4	18.3	5.8	1	585

* These are almost all Atwater's analyses; but the ox carcase is differently cut, and the parts somewhat differently named in America. The cuts quoted are as nearly as possible those usual in England. All the analyses are for the meat *as purchased*, beef and all succeeding items.

† Also 2.5 per cent. of the carbohydrate glycogen, the substance resembling starch which is constantly formed in the liver from sugar.

TABLE V.—continued.

	Refuse	Water	Protein	Fat	Ash	Calories per lb.
Loin	18.9	56.3	16.1	8.2	0.9	645
Rump	30.2	43.7	13.8	11.3	0.8	735
Shoulder (lean)	18.3	59.9	16.9	3.9	1	480
Liver	—	73	19	5.3	1.3	575
LAMB						
Breast	19.1	45.5	15.4	19.1	0.8	1090
Leg	13.8	50.3	16.0	19.7	0.9	1130
Loin	14.8	45.3	16.0	24.1	0.8	1315
Neck	17.7	46.7	14.6	20.4	0.8	1135
Shoulder	20.3	41.3	14.4	23.6	0.8	1265
Forequarter ..	18.8	44.7	14.9	21	0.8	1165
Hindquarter ..	15.7	51.3	16.5	16.1	0.9	985
MUTTON						
Leg	17.7	51.9	15.4	14.5	0.8	900
Loin	14.8	40.4	13.1	31.5	0.6	1575
Neck	26.4	41.5	12.2	19.6	0.7	1055
Shoulder	22.1	46.8	13.7	17.1	0.7	975
Forequarter ..	21.2	41.6	12.3	24.5	0.7	1265
Hindquarter ..	17.2	45.4	13.8	23.2	0.7	1235
Heart	—	69.5	16.9	12.6	0.9	845
Kidneys ..	—	78.7	16.5	3.2	1.3	440
Liver	—	61.2	23.1	9.0*	1.7	905
PORK						
Head	68.4	13.8	4.1	13.8	0.2	660
Loin Chops ..	19.3	40.8	13.2	26.0	0.8	1340
Middle Loin ..	19.7	38.6	12.7	28.9	0.7	1455
Shoulder	12.4	44.9	12.0	29.8	0.7	1480
Leg	10.3	45.1	14.3	29.7	0.8	1520
Feet	74.1	14.3	4.1	6.9	0.2	365
Liver	—	71.4	21.3	4.5†	1.4	615
Heart	—	75.6	17.1	6.3	1.0	585
	Water	Protein	Fat	Carbo-hydrates	Ash	Calories
‡Pork Sausages ..	55	12.3	21	1.0	2.5	1130
,, Cambridge	51.5	9.5	29.7	2.2	3.5	1450
Sausage, German	46.5	16.6	17.9	15.0	4.5	1340
Polony	45.6	17.3	32.6	0.5	2.8	1695

* Carbohydrate (glycogen) 5 per cent.

† Carbohydrate (glycogen) 1.4 per cent.

‡ Plimmer's Army Pork Sausage, 1918. Water 53.5, Protein 11.2, Fat 17.7, Carbohydrate 15.2, Ash 2.4, Calories 1238.

TABLE VIa

Cooked Meat

From Allen's *Commercial Organic Analysis*, Ed. 1898, by Tankard.

	Mutton	Lamb	Beef	Veal	Pork	Duck	Fowl
Water ..	39.8	59.9	45.6	51.9	44.9	64.1	67.4
Fat ..	26.8	11.9	24.2	11.4	19.7	6.1	6.7
Protein (N x 6.3)	29.0	24.7	26.5	33.2	32.6	27.1	24.3
Ash ..	1.9	1.6	1.2	1.6	1.6	2.0	1.4

TABLE VIb

Cooked Meat as purchased in U.S.A.

	Refuse	Water	Protein	Fat	Ash	Calories per lb.
Roast Beef (slices)	—	48.2	22.3	28.6	1.3	1620
Roast Lamb (leg)	—	67.1	19.7	12.7	0.8	900
Lamb Chops ..	13.5	40.1	18.4	26.7	1.2	1470
Roast Mutton, Leg (slices) ..	—	50.9	25.0	22.6	1.2	1420

TABLE VIc

Comparison of Meat Raw and Cooked

(König, quoted by Hutchison).

	Water per cent.	Protein per cent.	Fat per cent.	Extractives per cent.	Min. Matter per cent.
Beef, Raw	70.9	22.5	4.5	0.9	1.2
,, Boiled	56.8	34.1	7.5	0.4	1.1
,, Roasted	55.4	34.2	8.2	.7	1.4
Veal Cutlets—					
Raw ..	71.6	20.2	6.4	0.7	1.1
Roasted	57.6	29.0	11.9	.03	1.4

It is computed that generally 4 oz. cooked meat is produced from 5 oz. raw meat, the loss being to a great extent water.

TABLE VII

Poultry, etc.

Chiefly from Plimmer

	Percentage				Calories per lb.
	Bone and Offal	Water	Protein	Fat	
Turkey	47.8	35.5	11.8	4.0	388
Duck	40.1	21.9	7.3	29.9	1398
Goose	55.5	23.8	8.1	11.7	646
Pigeon	55.6	29.5	9.9	4.1	357
Pheasant	39.3	38.6	13.8	7.3	566
Partridge	49.3	34.9	11.9	3.1	352
Grouse	53.2	33.5	10.9	1.0	246
Chicken (fattened)* ..	—	55.5	17.8	7.2	635
„ (thin)*	59.0	29.1	10.1	1.3	245
Hare	61.7	28.3	8.4	0.7	188
Rabbit (frozen)	51.7	34.9	10.6	2.3	294
„ (tinned) ..	—	74.7	19.5	0.9	400

The water in these analyses, as also the protein and fat, represent the quantities in the portion of the animal which is eaten. There is a good deal of water, and some food value, of course, in the offal.

* It has been found difficult to select a suitable analysis for chicken or fowl. Every housekeeper knows the different conditions in which fowls may be purchased on the market. Plimmer's analyses were made on chickens that had not been fattened ; the Inter-Allied Commission gave very similar figures also for the war chicken. The first analysis above is therefore taken from a Farmers' Bulletin, to give the figures for an American well-fattened chicken.

Soups, Meat Extracts and Jellies.

In making soup from meat, it is customary to eliminate as much fat as possible ; but it is assumed that the " goodness," which is the protein, passes into the liquid. This is not the case, simply because proteins as a rule are not soluble in boiling water. Gelatin is, but we have noticed that gelatin is only a " grade D protein." A large part of the protein remains in the soup meat ; but some passes into the water in a coagulated state, and this will contribute some nutriment if the flocculent particles of which it consists are not removed in the process of " clearing " the soup. These particles are seen very well in home-made beef tea. The pleasant meaty flavour of stock is due to the *extractives*, which are nitrogenous substances of no food value, but having a stimulating action on digestion, as well as on appetite.

Ordinary stock consists of quite 93 per cent. of water, and at most 5 per cent. of nutritive matter. In an experiment quoted by Wiley, 1 lb. of beef and $\frac{1}{3}$ lb. of veal were boiled to produce only one pint of liquid. The composition of this was found to be :

Water per cent.	Protein per cent.	Fat per cent.	Extractives per cent.	Ash per cent.	Calories per lb.
95.2	1.2	1.5	1.8	0.3	85

Dr. Hutchison made a good beef tea from 1lb. of lean beef and 1 pint of water ; and obtained 28 oz. of liquid, containing $1\frac{1}{2}$–$1\frac{3}{4}$ per cent. protein, and about the same amount of extractives. All the flocculent matter was carefully retained. A clear soup therefore can hardly contain more than this, and probably contains less, as far as the liquid is concerned. The vegetables added,

and the cereal substances such as macaroni, tapioca and so on will, of course, bring nutriment. Thick soups may contain a fair amount of nourishment, especially when pulses are used for the thickening, as in pea or lentil soup. But it will be better to calculate their food value according to the recipes from which they are made.

Boiling bones extracts from them gelatin, with a varying quantity of fat. The jelly thus obtained has long been considered very nutritious, but it must be remembered that a 2 per cent. solution of gelatin makes a firm jelly, and even 1 per cent. will set. The composition of gelatin and of isinglass are given by Hutchison as below; and that of Agar-Agar, from another source is added.

TABLE VIII

	Percentage				
	Water	Albuminoid	Carbo-hydrates	Ash	Calories per lb.
Gelatin ..	13.6	84.2		2.1	1705
Isinglass ..	19	77.4		2.0	1730
Agar-Agar ..	21.8	5.9	68	4.1	—

The carbohydrate part of the last named is chiefly a substance called gelose, which according to Lusk is not digested, so that it has no food value. This substance, which is prepared from a Japanese seaweed, and has about 4 per cent. cellulose included in its carbohydrates, will give a jelly for 1 part in 500 of water.

The next Table given is for the analysis of various meat extracts. These are recommended now chiefly for stimulating effect; and because they put no strain on the digestion in the assimilation of the small amount of protein conveyed in a cupful.

TABLE IX

Meat Extracts and Juices (from Hutchison).

	Water	Protein		Extractives	Mineral Matter
		Insoluble	Soluble*		
Extracts—					
Oxo ..	39.7	4.6	13.5	24.1	18
Lemco ..	17.1	14.1		9.0	5.7
Nursing Oxo ..	23.3	5.8	33.5	21.7	15.7
Bovril	38.1	8.4	3.8	31.8	17.9
Invalid Bovril..	21.8	—	21.4	39.6	17.2
Brand's Essence	87.2	—	5.4	1.0	1.4
Armour ..	24.3	—	14.5†	40.6	19
Meat Juices—					
Valentine's ..	51.2	9.7		11.2	1.8
Armour's ..	74.1	8.3		9.5	7.5
Brand's ..	59.2	15.5		16.6	8.8
Marmite (yeast extract) ..	26.8	10.5		34.7	27

The quantity of each of these extracts used at a time is, of course, very small; between $\frac{1}{8}$ and $\frac{1}{4}$ oz. for one person.

See also Allen, *Commercial Organic Analysis*, Vol. IV. By desiccating 4 lbs. fresh lean meat 1 lb. dry substance can be obtained, of this 80 per cent. is nutritive protein matter; 20 per cent. fat, meat-bases, salts. *By no process can there be further concentration.*

* Albumoses and peptones, which may be said to be semi-digested proteins.

† Of this 5.0 is gelatin.

As early as 1897, Voit analysed the solid matter in ordinary Bovril and compared it with dry meat:

	Bovril Solid	Dry Meat
Organic Matter	75.3	94.6
Proteins	49.7	86.7
Extractives	25.6	7.8
Mineral	24.7	5.3

TABLE X

Bacon and Ham (Plimmer)

	Salt	Water	Protein	Fat	Calories per lb.
Back	4.5	24.6	9.1	59.9	2696
Streaky	4.2	27.0	10.3	54.2	2478
Gammon	5.9	35.6	11.7	44.6	2099
Whole side .. .. (less 3.7% for skin)	4.2	26.1	9.1	52.6	2388
Ham (whole	—	—	12.4	42.2	2010
„ (edible parts) ..	3.1	31.0	10.6	40.5	1905

FISH

Dr. Plimmer's Tables have been utilised here so as to give the actual percentages, in the fish as purchased, of the water, protein and fat in the portion we eat; and therefore the horizontal lines should add up approximately to 100. The proportion of water, protein and fat given does not include the proportion which is thrown away in the waste.

It is to be noted that 1 to 1½ per cent. of the protein is in the skin, and about ½ per cent. fat; so that some definite value is lost by discarding it.

TABLE XI (Plimmer)

	Percentage				Calories per lb.
	Waste	Water	Protein	Fat	
Bass (including skin)	35.1	49.8	12.6	1.8	312
Bream ,, ,,	55.9	34.2	7.6	0.6	167
Brill ,, ,,	35.8	47.8	13.5	1.8	327
Cod ,, ,, (sect'n)	12.3	70.3	15.7	0.1	296
Eel (excluding skin)	39.4	36.4	8.7	15.1	799
Flounder (including skin)	44.1	44.6	10.2	0.2	198
Hake ,, ,,	32.7	53.2	12.4	0.6	256
Halibut ,, ,,	25.9	58.0	14.5	0.4	287
Haddock (fresh) } excluding	34.7	51.6	12.0	0.2	232
,, (smoked) } skin	23.7	57.4	14.9	0.2	286
Herring (kipper) including skin	18.6	48.4	15.6	14.4	898
,, (bloater) ,,	19.2	52.5	16.7	10.4	749
Herring (fresh) ,, ,,	26.8	46.9	15.8	10.1	720
Mackerel ,, ,, ,,	39.6	41.2	11.8	7.0	515
Mullet (red) ,, ,,	33.3	49.1	12.8	4.1	411
Perch ,, ,,	31.3	51.7	12.6	0.9	272
Plaice ,, ,,	39.2	43.6	12.9	3.0	367
Salmon (section),, ,,	16.9	52.9	16.3	12.9	847
Smelts ,, ,,	36.6	48.9	11.3	1.6	278
Sole ,, ,,	26.6	54.9	15.2	1.5	346
Sole (lemon ,, ,,	27.9	55.3	14.3	0.7	250
Sprats (fresh) ,, ,,	26.0	49.4	12.6	10.7	686
,, (smoked) ,, ,,	20.8	39.4	21.2	14.9	1023
Trout (brook) ,, ,,	24.7	5.8	15.3	1.0	327
Turbot ,, ,,	40.0	45.8	11.1	1.5	270
Whitebait (whole fish with bone)	37.3	82.2	13.1	3.1	374
Whiting	36.4	51.1	11.3	0.1	215

TABLE XII

Hutchison gives Miss K. Williams' analyses of boiled fish, published in the *Chemical News* of 1911.

	Percentage			
	Water	Protein	Fat	Ash
Herring	60.5	26.5	10.0	2.2
Salt Herring	46.0	21.0	11.3	11.3
Sprats	75.8	14.0	6.6	1.6
Salmon	65.3	19.6	10.2	1.7
Trout	73.6	21.1	2.3	1.7
Smelts	80.7	15.9	1.9	0.9
Eels	61.1	16.7	17.1	6.8
Red Mullet	68.3	21.0	7.8	1.7
Mackerel	73.1	16.7	6.9	1.1
Cod	76.0	21.7	0.3	0.8
Salt Cod	72.3	20.1	0.3	3.9
Haddock	72.4	22.0	0.4	0.9
Hake	84.9	12.3	0.9	0.6
Whiting	78.8	16.9	0.4	0.4
Turbot	77.8	18.8	1.1	0.5
Halibut	74.5	20.3	4.0	1.0
Plaice	79.9	15.1	2.0	0.8
Soles	79.2	18.0	0.5	0.6
Lemon Soles	78.1	15.3	2.8	1.0

Langworthy gives for caviare and other fish roes prepared similarly:

Water 38.1, Protein 30.0, Fat 19.7 per cent., Calories 1530.

TABLE XIIa

Shellfish (Plimmer)

	Waste	Water	Ash	Protein	Fat	Carbo-hydtes	Calories per lb.
Oysters, with water	78.3	18.9	0.7	1.0	0.1	0.9	39
Mussels, ,, ,,	53.3	41.8	1.0	2.9	0.2	0.8	77
Scallops	75.9	14.1	0.3	3.1	0.1	0.3	68
Whelks	57.9	32.5	1.1	7.4	0.2	0.9	163
Winkles	77.7	16.1	0.6	4.0	0.5	1.1	116
Cockles, washed ..	—	61.8	18.0	13.9	0.5	5.8	387
Crab	59.4	29.3	0.7	5.9	0.0	0.3	210
Lobster	41.0	43.6	1.9	11.3	0.9	1.5	276
Shrimp	52.8	31.9	3.3	10.9	0.4	0.7	233
Prawn	54.0	32.8	2.4	10.5	0.6	0.0	220

TABLE XIII

Eggs (Plimmer)

	Percentage				Calories per lb.
	Water	Protein	Fat	Unde-termin'd	
Hen's with shell .. shell=10.1%	66.3	11.1	10.1	1.4	659
,, white alone 60%	87.2	10.7(1)	0.1	1.4	229
,, yolk alone 30%	47.1	15.5(2)	33.3	2.1	1730
Duck's with shell .. shell=11%	61.7	10.9	13.8	1.5	814
,, white alone 51%	87.5	10.0(3)	0.03	1.8	220
,, yolk alone 38%	45.1	15.3(4)	36.5	1.6	1854
Dried eggs (mean) ..	6.6	40.3	39.6		2598

If the proper factor for the egg proteins is used (see p. 32)

(1) becomes 11.5
(2) ,, 16.4
(3) ,, 10.7
(4) ,, 16.3

TABLE XIV

Egg Powders and Custard Powders *

	Starch	Albuminous Compounds	Colouring	Soda	Tartaric Acid	Phosphoric Acid	Water	Calories per lb. approx
Bird's Custard	86.2	0.59	0.88	—	—	—	11.8	1610
Goodall's Custard ..	84.4	0.58	.9	—	—	—	13.7	1580
Goodall's Egg Powder† ..	51.03	6.01	—	15.3	13.7	0.24	11.0	1035
Borwick's Egg Powder	26.4	3.0	—	50.7	10.3	—	9.6	545
Yeatman's Egg Powder	52.3	6.0	—	22.1	11.4	—	8.2	1080

It will be seen that the food value in each case is almost entirely given by *starch.*

MILK

There is a good deal of variation in the composition of cow's milk, particularly in the fat content, by which its quality is generally estimated. The figures given in Table II are the general average accepted by the Inter-Allied Commission ; but a good English milk is expected to contain as much as 4 per cent. of fat, instead of the 3.6 stated as the average. The legal minimum of fat for pure milk in Great Britain is $3\frac{1}{4}$ per cent. with 12 per cent. total solids, and 88 per cent. of water. In the United States the minimum varies from State to State,

* Analyses quoted by Hutchison from an article in *Food and Sanitation*, 1893.

† Contains in addition 2.7 per cent. of carbonates of calcium and magnesium.

the average being about $3\frac{1}{4}$, but it is as low as $2\frac{1}{2}$ in Rhode Island, and is 3.5 in three other States. In Table XV the milks of different animals and of the human being are compared.

TABLE XV

MILK OF VARIOUS KINDS (chiefly from Lusk)

Kind	Water	Total Solids	Casein	Albumen	Total Protein	Fat	Milk Sugar	Ash	Calories per lb.
Human	87.6	12.6	0.8	1.2	2.0	3.7	6.4	0.3	310
Cow ..	87.3	12.8	2.9	0.5	3.4	3.7	4.9	0.7	310
Goat	86.9	13.1	2.9	0.9	3.8	4.1	4.6	0.8	315
Sheep	83.6	16.4	4.2	1	5.2	6.1	4.7	1	410
Reindeer	67.2	—	8.4	1.5	9.9	17.1	2.8	1.5	976
Mare	90.6	9.9	1.3	.7	2	1.1	5.9	0.4	192
Ass	90.1	10.4	0.8	1.1	1.9	1.4	6.2	0.5	215

BUTTERMILK is given in Table II. The composition of WHEY is given by Hutchison as :

Water 93.6 per cent., protein 0.82, fat 0.24, sugar 4.65

CREAM is extremely variable. A Devonshire clotted cream has approximately the following parts :

Water 34.0, protein and sugar 7.2, fat 57.7 per cent.

Generally a clotted cream will have about 60 per cent. fat ; ordinary cream 30–45 per cent.

The chief difference between boiled and unboiled milk is in their water content. As boiled milk has lost a little water, its total solids are rather greater than before. The " skin " of milk, contrary to general belief, is chiefly albumen ; i.e., the other important protein in milk besides casein. The albumen coagulates, and

comes to the top, bringing with it a little fat and casein. Nevertheless the loss of protein in this way is negligible, because the skin actually weighs only an infinitesimal amount. The operation of forming a skin may have to be repeated a dozen times before enough is obtained for analysis.

Condensed Milks—These are being largely displaced by dried milks in domestic use, so that the analyses of the various kinds are not so much in request as they used to be.

TABLE XVI

(From Chalmers Watson)

	Percentage					Approx. Calories per lb.
	Water	Protein	Fat	Lactose	Cane Sugar	
Unsweetened Ideal	62	8.3	12.4	16.0	—	976
Sweetened Nestlé's	22.8	9.7	13.7	15.0	37.2	1712
Milkmaid ..	23.7	9.7	11.0	14.6	38.7	1632

It will be seen that the unsweetened milk if diluted to three times its volume (1 of milk to 2 of water) will be about the same strength as ordinary milk. The sweetened kind if diluted to the same amount will resemble ordinary milk in its content of protein and fat; but will still be extremely sweet, and is therefore generally more diluted [unless it is to replace sugar as well as milk, as it is in use with tea and coffee]. If diluted to 4 times its bulk it will contain protein only about 2.2, fat about 3.4 per cent., and still much more sugar than ordinary milk.

Cheap condensed milks are made from skim milk and always sweetened. Analysis from Allen :

Water 26.1, protein 10.1 (=N x 6.39), fat 0.3 or 0.4, lactose 10.1, sugar 45.0, ash 2.3.

TABLE XVII

CHEESE

Taken from Plimmer's Analyses.

	Percenatge				Calories per lb.
	Water	Protein	Fat	Undetermined	
Hard (full milk)					
English Cheddar ..	33.7	25.2	33.4	3.3	1939
Cheshire	34.9	22.7	33.8	3.7	1917
Gloucester	30.9	25.6	36.6	2.6	2068
Wensleydale	26.3	29.2	35.1	3.2	2083
Mean of above ..	31.6	25.7	35.0	3.1	2011
Hard (skim milk)					
Caerphilly	43.0	27.2	13.4	11.2	1280
Blue Dorset	33.7	41.9	14.4	4.6	1472
Hard (added cream)					
Stilton	24.6	26.3	42.8	2.5	2341
Extra hard					
Parmesan (Argentine)..	20.4	33.7	34.9	4.4	2181
Soft					
Little Wilts (mean) ..	41.1	22.1	30.3	3.1	1747

Dr. Plimmer points out that the "undetermined" matter is not lactose, but appears to be due to the partial breaking-up of some of the protein during the cheese-making process. A little of the protein undergoes "deaminization," and thus loses its nitrogen. The calorific value of the product would be the same as that of the protein ; and it is reckoned thus in the calculation of Calories.

TABLE XVIII

CEREALS

Plimmer's figures.

GRAINS COMPARED	Percentage				Carbo-hydrates by differ'ce	Calories per lb.
	Fibre	Water	Protein	Fat		
Barley	3.4	13.7	10.4	1.2	68.9	1525
Buckwheat ..	8.9	12.6	12.1	1.9	62.3	1464
Maize	1.4	10.6	9.9	4.2	72.5	1709
Millet, Japanese ..	2.6	10.5	11.2	2.9	68.9	1612
Oats	8.7	12.3	8.2	5.6	62.6	1553
Rice (unpolished	0.2	11.8	6.8	0.6	80.0	1640
,, (polished) ..	0.4	12.2	5.9	0.4	80.3	1620
Rye	1.7	11.6	6.6	1.2	77.3	1611
Wheat	2.0	13.8	10.9	1.2	70.4	1563
VARIOUS PRODUCTS FROM OR PARTS OF THE GRAINS						
Barley Flour ..	1.5	10.5	11.0	4.1	69.5	1665
,, Pot ..	0.7	10.5	7.0	0.8	79.9	1650
,, Pearl ..	0.8	12.7	7.4	1.2	76.7	1615
,, Kernel ..	0.9	10.5	8.0	1.8	77.8	1655
Maize Meal ..	0.3	9.6	9.9	2.1	77.4	1712
,, Hominy ..	0.4	11.2	7.0	0.5	80.5	1648
,, Cornflour ..	0.0	11.4	0.8	0.1	87.6	1648
Oatmeal Coarse ..	0.8	7.0	12.3	8.2	69.9	1875
,, Medium	0.8	6.9	11.9	8.6	70.0	1886
,, Fine ..	0.7	8.2	11.7	8.3	69.3	1857
,, Groats	1.6	7.7	12.0	8.4	68.3	1848
Rolled Oats (mean of 2) ..	0.7	8.5	13.1	6.5	69.5	1809
Rice Ground ..	0.2	11.1	6.4	0.3	81.6	1649
,, Flaked ..	0.1	11.3	6.1	0.3	81.7	1646
Rye Flour (mean of 2) ..	0.4	9.8	6.8	1.1	81.2	1681
Wheat Flour (mean of 2) ..	0.2	11.0	11.9	1.3	75.0	1688
Bran (mean of 2)	9.1	10.0	13.9	3.1	57.8	1545
Wheat Germ ..	2.9	9.9	24.3	7.5	51.1	1719
,, Semolina	0.3	11.4	11.4	1.1	75.3	1659
Wheat Meal ..	1.3	11.6	11.7	2.0	71.9	1639
,, Shredded	1.2	8.8	9.8	1.1	77.7	1674

TABLE XVIII—continued.

	Percentage				Carbo-hydrates	Calories per lb.
	Fibre	Water	Protein	Fat		
Grape Nuts ..	1.3	6.3	9.5	0.5	80.1*	1687
Force†	—	9.3	9.4	1.4	77.0‡	1665
Macaroni stick ..	0.1	10.9	12.8	0.2	75.5	1650
Spaghetti	0.1	10.8	10.9	0.3	77.4	1655
Vermicelli ..	0.1	10.4	11.5	0.1	77.4	1657
Arrowroot ..	—	13.2	0.2	—	86.4	1613
Potato Flour ..	—	12.9	0.3	—	86.5	1617
Sago	—	11.9	0.2	—	87.7	1636
Tapioca	—	11.9	0.2	—	87.7	1637
,, Bullet ..	—	10.6	0.2	—	89.0	1662
,, Seed ..	—	10.1	0.2	—	89.6	1670

TABLE XIX

Cooked Cereals, Various

	Water	Protein	Fat	Carbo-hydrate	Calories	Authority
Oatmeal ..	84.5	2.3	0.5	11.3	285	Lusk
Quaker Oats	92.5	1.6	0.3	6.2	157	K.Williams
Provost ,,	88.4	2.0	0.4	9.0	220	,, ,,
Rice	72.5	2.3	0.1	23.8	505	Lusk
,, ...	52.7	5.0	0.1	41.9	876	Hutchison from Atwater
Macaroni ..	78.4	2.3	1.4	15.6	405	

The noticeable thing about the above figures is their variation.

Macaroni and rice are usually boiled in plenty of water and allowed to absorb as much as they can. But all cooks know that the amount of water absorbed depends somewhat on the time and conditions of boiling.

* 20.6 of this is a sugar, not starch.
† Hutchison.
‡ 11.0 of this is a sugar, not starch.

The pappy, over-soft cooked macaroni common in England, and very different from macaroni as cooked by Italians, shows this; but the difference is much more marked in the case of rice, which may appear at table almost dry, " every grain separate," or as a sticky mass. By the figures Atwater's boiled rice seems to be of the nature of curry rice; Lusk's rice cooked to a pulp. The first has absorbed only about $1\frac{1}{7}$ of its weight of water; the second $2\frac{1}{7}$. The macaroni has absorbed about 3 times its weight.

In cooking porridge a certain amount of oatmeal is usually measured into a certain amount of water, and taste and custom fix the proportion in each case. The usual allowance is about 4oz. oatmeal to one pint or 20oz. of water (5 times as much water), and this will give about the same percentage of water as the first analysis above. Miss Williams' porridges seem to have been made with rather more water; the recipe for workhouses is 3oz. to a pint. Gruel will contain 2oz. or less to the pint. Stirabout, in Ireland, is 5oz. oatmeal and 3oz. maize-meal in $2\frac{1}{2}$ pints of water boiled down to $1\frac{1}{2}$ pints (Burney Yeo).

BREAD

Only English analyses of bread are given here, and of bread containing wheat only.

TABLE XXa

	Fibre	Water	Protein	Fat	Carbo-hydrates	Calories per lb.
Plimmer						
1920 Scotch (white)	0.1	37.9	7.2	0.9	47.9	1076
,, ,, (brown)	0.5	35.8	7.3	1.2	53.1	1174
Hutchison			(N x 5.7)			
White (average) ..	0.3	40	6.5	1.0	51.2	—
Wholemeal ,, ..	1.5	45	6.3	1.2	44.8	—

TABLE XXB

Patent Breads (Hutchison)

	Water	Protein	Fat and Carbohydrates	Remarks by H.
V.V.	40.4	7.5	51.6	Very good white breads
Maltina (white) ..	44.5	5.9	54.6	
Nevill	37.5	6.4	53.9	
,, (wheatmeal)	41.5	8.0	49.3	
Maltina (brown)	45.1	7.0	46	Whole meal malted, with some coarse fibre.
Bermaline ,, ..	38.0	8.1	50.3*	Malted; carbohydrates 10 per cent. soluble. But little cellulose.
Hovis	45.0	9.9	42.3*	A germ bread. But little cellulose.
Veda	24.6	9.4	63.5	Malted: containing 53 per cent. soluble carbohydrates.
Cytos	42.3	8.1	48.3	Germ and malt; very little cellulose
Daren	46.6	7.9	44.5	Malted: containing also wheat germ and rye meal. Very little cellulose.

Moisture in Bread. It has been already seen in Hutchison's Tables that the moisture retained in bread varies with the constituents; malted, germ, and wholemeal flour having a tendency to retain more moisture than ordinary white flour. Besides the variations the following Table from Wood shows the variation with size and with kind of loaf; and the next one shows the loss of water as the bread gets staler. In Dr. Hutchison's *Food* the process of rendering stale bread fresh by putting it into the oven is discussed and explained.

* These figures are for carbohydrates alone; Bermaline contains 1.7 fat and Hovis 1.6 in addition. The fat content of the other breads will be 1.0 to 1.2 per cent.

TABLE XXI

(Prof. T. B. Wood)

	Percentage of Water
Cottage loaves of white flour	31.7
Tinned „ „	32.7
Small fancy loaves	33.7
Tinned loaves of Standard „	35.9
„ „ brown or germ flour	40.0

TABLE XXII

(From Goodfellow's *Dietetic Value of Bread*).

Hours	a 2lb. loaf loses
In 12	$\frac{2}{7}$ oz. water
„ 24	$\frac{2}{3}$ oz „
„ 36	$1\frac{3}{5}$ oz. „
„ 48	$2\frac{14}{25}$ oz. „
„ 60	$3\frac{1}{2}$ oz „
„ 72	$4\frac{1}{2}$ oz. „

Toast is given by Lusk as :

Water 24, protein 8.9, fat 1.4, carbohydrates 60.3, unavailable 4.1, Calories 1390.

But the water present, and the unavailable part, depend greatly on the manipulation, as well as on the thickness of the bread.

Crust and Crumb. Analyses by Barral are quoted by Hutchison and by T. B. Wood :

TABLE XXIII

	Crust	Crumb
Water	17.1	44.4
Insoluble Protein	7.3	5.9
Soluble „	5.7	0.7
Dextrine and Sugar	4.9	3.8
Starch	62.6	43.5
Fat	1.2	0.7
Ash	1.2	0.8

The percentage of crust and crumb in a loaf obviously depends on its size. The only available Table on the subject is a rather old one (Birnbaum, 1878).

TABLE XXIV

	Weight of Loaf	Percentage Crumb	Percentage Crust
I ..	about 14 oz.	55.2	44.8
II ..	„ 31 „	59.7	40.3
III ..	„ 63 „	64.3	35.7
IV ..	„ 70 „	71.2	28.8

We will now give some of Dr. Hutchison's analyses of Patent Foods. Some of these consist largely or wholly of dried milk, others of baked or malted wheat or barley flour. Malted flour contains most of its carbohydrate in a soluble condition as maltose or a kindred sugar, not as starch.

TABLE XXV

	Water	Protein	Fat	Carbo-hydrates	Mineral	Remarks
Dried human milk for comparison	—	12.2	26.4	52.4	2.1	
Glaxo ..	3.5	22.2	27.4	41.0	5.9	Dried milk, cream fat, and lactose. No starch.
Horlick ..	3.7	13.8	9.0	70.8	2.7	Dried milk : wheat flour, malt and bicarbonate of soda.
Mellin ..	6.3	7.9	—	82.0	3.8	Malted flour, starch completely converted.
Benger ..	4.5	10.2	1.4	83.2	0.8	Flour with pancreatic extract which converts starch during cooking.
Allenbury I	5.7	9.7	13.5	62.3	3.75	Modified cow's milk.
Allenbury II ..	3.9	9.2	17.6	66.8	3.5	Same with some malted flour.
Ridge's Food ..	7.9	9.2	1.0	81.2	0.7	Baked flour; carbohydrate chiefly starch.
Allenbury (malted)	6.3	9.2	1.0	82.8	0.5	Almost completely malted flour.
Frame Food	5.0	13.4	1.2	9.4	1.0	Baked flour with sugar and extract of bran.
Bananina..	9.5	4.1	0.4	84.0	2.1	Very starchy.
Virol ..	21.1	2.8	12.3	59	1.6	Bone marrow : yolk of egg, malt extract : lemon juice.
Plasmon } Protene }	(Pure Casein)					
Sanatogen	Casein and Sodium-glycero-phosphate.					

FRESH VEGETABLES

It has been possible to obtain from Plimmer's Tables analyses for vegetables which give, first, the percentage of waste removed in the preparation for the table, and secondly, the percentages of the various nutrients actually consumed. All these percentages, with the fibre and ash, total up to about 100. Thus, to take an example at

random—of a cabbage weighing 1lb., just over $\frac{1}{2}$ (51.6 per cent.) will be thrown away, and rather under $\frac{1}{2}$ (42.8 per cent.) will be water; but there will be $\frac{1}{26}$ (about 3.9 per cent.) of a lb. carbohydrate eaten, and about $\frac{1}{140}$ (0.7 per cent.) lb. protein. Some amount of water and of all the other ingredients is thrown away in the waste, as unavailable. On looking down the column for water content, it will therefore seem unexpectedly low for vegetables, for the water is only that present in the edible part, a good deal of water being thrown away in the waste. Nevertheless, if the vegetable is now boiled, it will absorb a good deal of water, and the percentage will rise again.

The kind of waste varies according to the vegetable.

For Legumes.	Pods, or stringy parts of pods.
Onions, Potatoes, Cucumber	Skin.
Turnips, Parsnips, Salsify, etc.	Scrapings.
Cabbages Cauliflowers, Leeks Lettuces, etc.	Outside leaves and stalks. Occasionally roots and rootlets.
Watercress, Parsley	Thick stalks
Mushrooms	Stalks and skins.

For potatoes the amount of nourishment in the skins is given separately, as they are quite often eaten; in the other cases it has not seemed necessary to reproduce the analyses of waste given in the Tables.

TABLE XXVI

Analyses of whole as purchased.

	Waste	Water	Ash	Fibre	Protein	Carbo-hydrte	Fat	Calories
LEGUMES								
Green Peas ..	57.5	32.3	0.4	0.8	2.3	6.5	0.2	172
Broad Beans	64.1	25.1	0.4	0.9	2.5	6.8	0.1	177
Scarlet Runners	8.3	85.5	0.6	0.7	1.2	3.6	0.1	93
French Beans	8.9	83.4	0.6	0.9	1.7	4.4	0.1	117
Butter ,,	3.0	88.0	0.7	0.8	2.0	5.4	0.1	137
TUBERS & ROOTS								
Potatoes (new)	2.6	74.2	0.8	0.4	1.6	20.4	—	410
,, (skin)	—	2.1	0.1	0.1	0.1	0.2	—	6
,, (old)	7.9	70.1	1.8	0.7	1.9	18.1	—	373
,, (skin)	—	6.1	0.4	0.4	0.2	0.9	—	21
Artichoke Jerusalem	?	80.0	1.3	0.7	1.9	17.4	—	360
Beet, edible only	—	56.0	0.8	0.6	0.7	3.8		86
Carrot ,, ..	—	67.8	0.9	1.1	1.2	9.0	0.1	193
Kohlrabi whole	23.3	70.1	0.9	0.5	1.7	3.4	—	96
Parsnip ,, ..	13.2	63.0	0.9	2.6	1.5	18.3	0.4	3.5
Radish (edible part) ..	—	42.6	0.4	0.5	0.5	1.5	0.1	39
Salsify ..	12.6	66.8	1.0	1.4	2.4	15.6	0.1	338
Scorzonera ..	20.0	58.2	0.7	1.8	3.1	15.9	0.2	360
Swede ..	15.5	7.50	0.5	1.2	0.8	6.8	0.1	145
Turnip ..	12.6	81.3	0.6	0.5	1.1	3.8	0.1	95
BULBS								
Garlic ..	8.2	58.7	1.3	0.8	4.3	26.6	0.1	578
Leek ..	56.4	37.2	0.5	0.7	1.1	4.1	—	98
Onions, English	4.5	82.8	0.5	0.6	1.2	10.3	0.1	219
,, Spanish	2.0	92.3	0.4	0.7	0.6	0.6	4.0	87
OTHER PARTS								
Artichoke Green ..	68.0	26.1	0.4	1.0	0.9	3.6	—	84
Asparagus ..	57.2	38.9	0.4	0.4	1.3	1.8	—	58
Aubergine ..	—	93.1	0.5	1.4	0.6	4.3	0.1	95
Batavia ..	46.0	50.3	0.5	0.6	0.8	1.8	—	50
Brussels Sprouts	23.2	67.8	0.8	0.8	2.8	4.4	0.1	140
Cabbage ..	51.6	42.8	0.4	0.5	0.7	3.9	—	87
,, Red	42.6	51.3	0.6	0.5	1.3	3.7	0.1	96
,, Savoy	43.1	51.3	0.6	0.6	1.5	2.9	0.1	84

TABLE XXVI—continued

	Waste	Water	Ash	Fibre	Protein	Carbo-hydr'te	Fat	Calories
OTHER PARTS								
Cauliflower	47.8	47.1	0.5	0.5	1.0	3.1	0.1	80
Curly Kale ..	30.9	57.6	1.5	1.0	2.7	6.1	0.3	176
Celery ..	11.5	82.9	0.9	0.7	0.5	3.4	0.1	76
Corn Salad ..	3.9	88.6	1.6	1.1	1.7	2.9	0.2	94
Cucumber ..	17.4	79.9	0.3	0.2	0.5	1.6	0.1	42
Endive ..	26.4	68.7	0.8	0.6	1.3	2.1	0.1	66
Lettuce ..	36.5	60.6	0.5	0.4	0.7	1.2	0.1	41
Marrow (green)	32.6	62.7	0.3	0.4	0.3	3.5	—	72
,, (yellow)	44.6	53.6	6.2	0.2	0.1	1.2	—	25
Mushroom ..	20.6	72.5	0.9	0.7	3.6	1.6	0.2	104
Parsley ..	27.8	56.9	2.1	1.6	2.7	8.4	0.5	228
Rhubarb ..	17.9	77.5	0.6	0.5	0.5	3.0	0.1	68
Sea Kale ..	22.9	72.0	0.4	0.6	1.2	2.9	—	77
Sprouting Broccoli	13	68.7	2.2	1.6	4.1	10.0	—	277
Spinach Perpetual ..	29.5	65.8	1.1	0.5	1.2	1.8	0.1	58
Tomato ..	—	93.5	0.5	0.7	0.7	4.5	0.1	101
Watercress	50.0	46.3	0.5	0.3	0.7	2.1	0.2	60

COOKED VEGETABLES

TABLE XXVII

COOKED POTATOES, PEAS AND BEANS (PLIMMER)

	Water	Protein	Fat	Carbo-hydrate	Calories per lb.
New, without skins ..	74.4	1.3	—	18.9	376
,, with ,, ..	77.2	1.5	—	19.9	399
Old without skins ..	74.1	1.8	—	14.7	307
,, with ,, ..	80.2	2.0	—	16.0	337
Green Peas	78.3	4.6	0.6	13.3	358
Broad Beans	75.3	6.1	0.2	14.1	384

Should potatoes be put to boil in cold or hot water? The English tradition that old potatoes should be put into cold water, new into hot water, is not supported by American investigators.* Their conclusions are :—

1. In order to obtain the highest food value, potatoes should not be peeled before cooking.

2. When potatoes are peeled before cooking the least loss is sustained by putting them into hot water, and boiling as rapidly as possible. Even then the loss is very considerable.

3. If potatoes are peeled and soaked in cold water before boiling the loss of nutrients is very great.

From the same bulletin we learn that the actual skin of the potato, and the layer immediately under the skin, contain a larger proportion of protein and of mineral constituents than the rest of the tuber, and a small proportion of starch. It is experienced by everyone that to preserve the mineral constituents of the potato, by cooking in the skin, greatly improves its flavour. The quantity of protein in this food is inconsiderable.

The *Bulletin* No. 43 already quoted makes the following statement :—" In 100lb. of uncooked cabbage there are but $7\frac{1}{2}$ lb. of dry matter, and of this dry matter from $2\frac{1}{4}$ to 3 lb. are lost in the process of cooking. This loss seems to be unavoidable unless the cabbage is cooked in such a manner that the water in which it is boiled is also used."

It is not of great practical use to give figures for the percentage of nutriment lost in the water when vegetables are boiled ; because with them, as with potatoes, the amount varies with the conditions, such as the size

* *Bulletin* No. 43. Experiment Stations, U.S. Department of Agriculture.

to which they are cut, and so on. Meanwhile it has been learned by most people who study cooking that the "conservative" cooking of vegetables, by which the water, if any, in which they are cooked is utilised, is the most economical way of availing ourselves of the food material they contain. The possibility of destroying vitamines, however, by slow long cooking has already been mentioned. Nevertheless, we do not know yet all there is to be known about the effect of cooking on the vitamines in vegetables.

TABLE XXVIII

Dry Pulses (Plimmer).

	Water	Ash	Fibre	Protein	Fat	Carbohydrate by Diff	Calories per lb.
Peas							
Whole green ..	13.8	2.7	5.4	20.4	0.6	57.1	1466
Split ,, ..	11.1	2.7	0.9	22.1	0.8	62.4	1605
,, yellow ..	12.6	2.4	1.0	20.3	0.7	63.0	1578
Pea flour	8.7	2.7	1.1	21.9	1.4	64.2	1660
Lentils							
Flour	9.9	3.1	1.2	21.4	0.9	63.5	1617
Whole (brown) ..	12.2	2.3	3.1	22.2	0.5	59.7	1544
Split (red) ..	12.3	2.1	1.2	20.1	0.4	63.9	1579
Beans							
Butter ..	11.2	4.0	3.3	18.6	0.7	62.2	1532
Haricot (large)	12.2	4.4	3.7	16.7	1.7	61.3	1522
,, (small)	11.1	3.5	2.6	17.8	0.5	64.5	1551

TABLE XXIX

Fresh Fruits (Plimmer).

(See remarks on Fresh vegetables, pp. 105, 106)

	Percentage							Calories per lb
	Waste	Water	Ash	Fibre	Protein	Fat	Carbohyd'te (Sugar)	
Apples ..	9.2	77.5	0.3	0.7	0.3	0.2	9.8	196
Bananas ..	43.3	40.2	0.5	1.2	0.6	0.1	14.1	278
Cherries ..	12.5	74.3	0.4	0.8	0.8	0.1	11.2	227
Currants								
Black ..	5.5	76.4	0.8	2.3	1.2	0.2	7.6	172
Red ..	4.4	81.9	0.6	3.8	1.2	0.1	6.0	138
White ..	3.6	82.3	0.7	2.7	1.1	0.1	5.6	129
Damsons ..	8.3	76.8	0.5	0.4	0.4	0.2	7.1	148
Figs	19.6	70.2	0.5	0.6	0.6	0.1	8.8	179
Gooseberries								
Cooking	0.2	89.5	0.4	1.9	0.7	0.1	5.1	112
Eating ..	0.3	88.6	0.4	1.2	0.7	0.1	6.8	144
Grapes ..	5.1	80.3	0.5	0.6	0.6	0.1	13.2	261
Grapefruit ..	30.0	64.3	0.2	0.4	0.4	0.1	4.0	86
Greengages ..	5.5	78.1	0.6	1.9	0.7	0.2	10.2	211
Lemons ..	32.1	61.8	0.1	0.1	0.2	0.2	1.0	31
Melons, Spanish	37.2	58.7	0.2	0.2	0.2	0.1	2.7	58
Nectarines ..	5.3	83.2	0.5	0.1	0.8	0.1	8.5	177
Oranges ..	25.1	65.1	0.4	0.3	0.6	0.1	6.6	137
Peaches ..	7.0	83.2	0.6	0.5	0.7	0.1	4.4	99
Pears (Cooking)	12.0	73.7	0.3	1.9	0.4	0.1	6.8	138
(Eating)	12.7	74.0	0.3	1.4	0.3	0.1	7.9	144
Pineapple ..	32.7	58.4	0.3	0.3	0.3	0.0	7.5	145
Plums(Cooking)	6.2	82.6	0.4	0.9	0.5	0.3	7.3	157
(Eating)	4.5	81.7	0.4	0.7	0.4	0.3	7.6	163
Pumpkin ..	33.5	63.4	0.3	0.2	0.3	0.0	1.9	41
Raspberries	8.5	79.4	0.5	2.8	1.1	0.1	6.0	136
Strawberries	5.0	85.6	0.5	0.8	0.7	0.1	7.9	162

TABLE XXX

Dried Fruits (Plimmer).

	Water	Ash	Fibre	Protein	Fat	Carbohydrates (Sugar)	Calories per lb.
Apple rings ..	25.1	1.1	2.6	0.9	0.6	58.7	1133
Apricots	27.9	3.3	2.6	2.5	0.3	49.6	1037
Currants	20.5	2.6	2.3	1.7	0.3	42.0	826
Dates, 15 per cent. for stone ..	18.5	1.7	2.0	1.4	0.1	59.2	1131
„ Turban (11 per cent. for stone)	19.3	2.0	1.8	1.6	0.2	59.4	1280
Figs	20.8	2.3	4.2	2.0	0.5	56.5	1109
Peel (candied) ..	22.0	1.3	2.3	0.3	0.1	66.8	1252
Prunes (16.2 per cent. for stone) ..	23.5	1.6	1.5	2.5	0.2	33.9	685
Raisins	19.3	2.5	4.1	2.2	0.3	61.2	1192
Sultanas	18.5	2.3	1.1	1.7	0.3	64.9	1251

TABLE XXXI

Jam, etc. (Plimmer).

	Water	Ash	Fibre	Protein	Carbohydrates as *		Calories per lb.
					Glucose	Cane Sugar	
Damson	25.0	0.4	0–7	0.3	53.6	16.2	1306
Strawberry ..	29.3	0.3	1.4	0.3	47.4	19.0	1241
Plum	24.0	0.8	0.6	0.2	39.6	30.4	1305
Plum and Apple ..	27.9	0.2	0.7	0.2	27.2	42.3	1296
Rhubarb	32.6	0.4	1.5	0.5	45.7	19.9	1229
Marmalade ..	26.6	0.4	1.0	0.3	43.9	25.5	1296
Home-made Gooseberry	40.2	0.7	3.5	0.9	55.3	0	1045
Golden Syrup ..	15.1	0.9	—	0.3	44.5	31.9	1426
Treacle	23.4	4.2	—	0.2	19.1	40.8	1118
Honey	18.3	0.3	0.1	0.4	69.2	2.2	1290

* see page 3.

TABLE XXXII

Nuts (Plimmer).

A. In Shells

	Edible	Water	Ash	Fibre	Protein	Fat	Carbo-hyd'tes	Calories per lb.
Almond	29.7	0.9	0.9	1.1	4.7	17.0	5.2	901
Brazil nut	53.2	1.5	1.8	1.1	7.0	37.4	4.3	1788
Chestnut	85.5	37.9	0.8	1.4	2.6	1.6	41.2	882
Coconut	71.4	37.7	0.5	0.8	2.1	24.9	4.9	1181
Filbert or Cob	40.5	4.5	1.1	1.0	5.8	20.9	7.2	1124
Peanut	69.3	2.8	1.7	2.5	13.9	33.0	15.3	1935
Walnuts, dried	45.0	1.4	1.0	0.6	9.3	26.5	6.2	1406
,, fresh	40.6	4.6	0.7	0.4	6.4	23.9	4.5	1211

B. Edible parts only.

(Omitting water, ash and fibre).

	Protein	Fat	Carbo-hydrates	Calories per lb.
Almond	18.8	55.3	16.0	2979
Brazil nut	13.2	70.4	8.1	3366
Chestnut	3.0	1.9	48.2	1032
Coconut flesh ..	4.2	48.5	7.7	2267
,, milk	0.2	—	5.2	100
Filbert	14.3	51.6	17.8	2774
Hazel	13.2	63.2	14.3	3177
Peanut	20.1	47.6	22.1	2793
Pine kernels	31.4	48.0	10.6	2806
Walnuts, dried ..	13.6	66.4	14.0	3314
Walnuts, fresh ..	15.8	58.8	11.1	2981

TEA, COFFEE AND COCOA.

It has already been stated that Cocoa is the only one of these three beverages that has notable food value. The following table gives the quantities of all three substances assumed by various authorities as suitable to add to a pint of water, and is interesting as showing the variation in the estimates.

A is from Hutchison's *Food and Dietetics.*

B is from Farmer's Bulletin No. 249, U.S.A. Dept. of Agriculture.

C is from Rowntree's *Poverty.*

TABLE XXXIII

Quantity in oz. to 1 pint water.

	A	B	C
Tea ..	0.66	0.5	0.2
Coffee ..	2	1	0.4
Cocoa ..	0.83	0.5	0.5

The following Tables, A and B, taken almost entirely from Mrs. Rose's *Feeding the Family*, illustrate the recent American methods of keeping the Calorie value of food before caterer, cook and consumer. To select a dish or plan a diet scientifically by means of tables of this kind is a comparatively easy task. But the reader must once again be warned that she is dealing with only rough and averaged figures. The amount of possible variation from the figure given here for any particular sort of food is usually very considerable. If it can be called slight for food simple in constitution such as sugar or tapioca, it is certainly not slight for meat, more or less fat, fish, more or less watery, or fruit of extremely variable

sweetness. Thus the figures to be given, though useful as guides or indications, should not be treated with exaggerated respect.

The use of the word " cupful " in the tables reminds us of the difficulties we constantly experience in using measures instead of weights. What are the sizes of the cup and the tablespoon respectively mentioned ? As the corresponding weight in ounces is given in the next column it is easy for the enquirer to find the sizes by experimental trial. American demonstrators seem to avoid the " heaped " tablespoonful as ambiguous, and a *level* spoonful or cupful is used. The cup is stated to be a half-pint one. But the American pint is only .833 of the English pint ; whereas a half-pint cup in England would contain about 10 ounces of water, the cup mentioned in the Table contains about $8\frac{1}{3}$ ounces. A cook or demonstrator can doubtless find a breakfast cup* about this size, and such a one should of course then be continually used. It should be supplemented by a tablespoon such that 16 fillings fill the cup ; (which again seems to be smaller than the average English tablespoon). When the American Tables mention a teaspoon it appears that $3\frac{1}{2}$ fillings make a tablespoon. In England 4 is more usual, but this utensil varies very much in size. However, the reader must make up her mind that if she uses Tables A and B her cup and tablespoon *must* correspond to those in the Tables. *Any cup and tablespoon will not do.*

Dimensions of slices are given in inches (″) and portions of inches. There is no ambiguity here.

* Dr. Hutchison takes the average English breakfast cup to be 8oz., tea cup 4oz. ; but Mrs. Beeton's breakfast cup is a half-pint one or 10ozs., and her tablespoon one-sixteenth of this or five-eighths of an ounce.

Table A gives 100-Calorie portions of articles of food as they appear at table, described (1) by some approximate volume measure, (2) by weight. The third column is the number of Calories in this portion which are supplied by the protein in the food, (*i.e.*, the *percentage* supplied by protein, as the whole portion is 100 Calories.)

It will be remembered that on p. 42 it is suggested that the amount of protein needed in a diet may be expressed in this way, i.e.—of the whole number of Calories a certain proportion—10-15 per cent.—should be supplied by protein. Given the weight of protein in the diet in ounces, we can at once find the number of Calories it supplies by multiplying this weight by 116. It is very usual now in American tables to analyse the Calories altogether into those supplied by protein, fats, carbohydrates. But in the Tables in this book all complete analyses are still by weight ; those giving protein content only are generally statements of Calories in protein.

Two columns on the right hand side are left blank, and also blank spaces under the various food categories, for further data collected by the student. It is suggested that the comparison of the prices of 100-Calorie portions of different foods might form the entries in one of the columns.

Table A

(Taken chiefly from M. S. Rose, *Feeding the Family*).

100 Calorie portions of food as usually served at table.

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
Meat, etc.					
Beef roast, rib, lean	Slice 5 × 2½ × ¼ ins.	1.6	46		
Beef boiled round lean		2.2	90		
Beef corned, fat		1.0	21		
,, ,, tinned		1.25	30		
,, sirloin steak, broiled					
lean	Slice 2 × 1½ × ⅜ ins.	2.0	47		
fat	,, 1¾ × 1½ × ⅜ ,,	1.3	31		
Veal, roast leg	Slice 2 × 2¾ × ⅛ ins.	2.3	71		
cutlets ..		2.0	30		
Mutton, roast leg	Slice 3 × 3¾ × ⅛ ins.	1.2	33		
Lamb, roast leg	Slice 3½ × 4½ × ⅛ in.	1.8	41		
,, broiled ,, chops ..	Chop 2 × 2 × ½ ins.	1.6	40		

TABLE A—*Continued.*

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
Pork, steak ..		.7			
Pork, ribs roast		.8			
Bacon		.5	13		
Ham, boiled ..	Slice $4\frac{3}{4} \times 4 \times \frac{1}{8}$ ins.	1.3	29		
Sausages ..	$1\frac{3}{4}$ sag., 3ins. long $\frac{3}{4}$ dia. after cooking	1.1	20		
Capon, roast ..	Slice $4 \times 2\frac{1}{2} \times 1\frac{1}{4}$ ins	1.7	51		
Turkey roast		1.3	40		
FISH					
Halib't st'k broil'd	Piece $3 \times 2\frac{1}{4} \times 1$ ins.	3	61		
Mackerel broiled		2.6	56		

TABLE A—*Continued*

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
Salmon, tinned	scant ½ cp	1.8	45		
Sardines, ,,	3–6	1.7	46		
Lobster, ,,	¾ cup	4.3	86		
Oysters	6–15	7.2	49		
Shrimps	½ cup	3.2	91		
SOUPS & SAUCES					
White soups, thickened with starchy material and fat—"cream of." ..	about ½ cup	about 4oz.	12–16		
Pea, bean, and lentil soups ..	⅔-1cup	6–8oz.	20–28		
Consommé, .. bouillon, meat extracts ..	4 cups	32–34 oz.	84*		
White sauce ..	¼ cup	2.4	8		
Tomato sauce ..	5 tbsp.	2.5	5		

* This probably includes all nitrogenous material, i.e., extractives. See p. 88.

TABLE A—*Continued*

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
Eggs (boiled) ..	one large	2.1	20		
,, scrambled	¼cup	2.1	20		
raw whites	7	6.9	97		
,, yolks	2	1.0	17		
CHEESE					
American ..	1⅛ in. cube	.8	26		
cream ..	2×1×⅜in. piece	.9	25		
CREAM					
thin 18 % fat ..	¼cup	1.8	5		
thick, 40 % fat..	1⅓tbsp.	.9	2		
whipped ..	2tbsp.	.9	2		
MILK					
cond. sweet. ..	1½tbsp.	1.1	11		
,, unsweet. ..	3¾tbsp.	2.1	23		
whole	⅝ cup	5.1	19		
skim	1⅛cup	9.6	37		
buttermilk ..	1⅛ ,,	9.9	33		
whey	1½ ,,	13.0			

TABLE A—*Continued*

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
Sugar	2tbsp. scant	.9	—		
	3½ full size lumps	.9	—		
Treacle ..	1½tbsp.	1.2	—		
Honey	1tbsp.	1.1	1		
Marmalade ..					
American ..		1	1		
Jam, English ..		1.4	1		
Milk chocolate	2¼ × 1 × ⅛in.	.7	7		
Ginger, (crystallised)	6 pieces, 1½ × ¾ × ¼in.	1	1		
Cherries, candied	10 medium	1	1		
Dates	3 or 4	1.1	2		
Figs	1½ large	1.1	5		
Raisins ..	2doz. or ¼cup	1.1	3		
NUTS					
Almonds ..	12-15 nuts	.5	13		
Brazil-nuts ..	2 nuts	.5	10		
Chestnuts ..	7 ,,	1.5	10		
Filberts.. ..	8-10 nuts	.5	9		
Pea-nuts ..	20-24 single nuts	.6	19		
Pine-nuts ..	¼cup	.6	22		
Walnuts ..	8-16	.5	11		

TABLE A—*Continued*

Kind of Food.	Description of portion in American Units.	Wt. in Oz.	Per cent. of Calories from protein		
FRUIT, fresh					
Apples	1 large	7.5	3		
Bananas ..	,,	5.5	5		
Grapes	22 grapes	3.7	5		
Olives ..	6-8	1.7	3		
Oranges ..	1 large	9.5	7		
Pears	2 medium	6.3	4		
Pineapple, fresh	2 slices, 1″ thick	8.2	4		
Plums	3-4 large	4.4	5		
Strawberries ..	1⅓ cups	9.0	10		
FRUIT, tinned					
Apricots ..	3 large halves and 2tbsp. juice	4.8	5		
Peaches ..	2 large halves and 3tbsp. juice	4.7	6		
Pears	3 halves and 3 tbsp. juice	4.7	2		
Pineapple ..	1 slice and 3 tbsp. juice	2.3	1		
Potatoes, baked	1 medium	3.0	11		
,, boiled	,,	3.6	11		
,, mashed	½ cup (scant)	3.1	7		
,, chips	8-10 large pieces	.6	5		
Beans, baked (tinned) ..	½ cup	4.6	13		
Carrots ..	4-5 young carrots	10.1	10		
Green peas (shlld.)	¾cup	3.5	28		

TABLE A—*Continued*

Kind of Food.	Description of portion in American units.	Wt. in Oz.	Per cent. of Calories from Protein.		
Bread, white ..	1 sl. 6×3½×½in.	1.3	14		
Whole wheat	„ 5×2¾×½in.	1.4	16		
Brown ..	do.	1.5	9		
Rolls, French ..	one	1.3	12		
Macaroni, cooked	1 cup	5.2	15		
Rice, boiled ..	¾ „	4.0	9		
Oatmeal, cooked	1 „	7.9	17		
Butter	ordinary ball or pat. 1tbsp.	.4	—		
Bacon fat ..	1tbsp.	.4	—		
Beef dripping	„	.4	—		
Margarine (oleo)	„	.5	—		
Olive Oil ..	„	.4	—		
BEVERAGES					
Cocoa, half milk 1tbsp. to cup 2 tbsp. sugar	⅔ cup	5.5	14		
Chocolate half milk .. 1 square to cup 1tbsp. sugar	½cup, scant	4.1	10		

Notes on Table A

Green Vegetables and Salads have not been included in the items taken from the American list. In the former case the 100 Calorie portion for a raw vegetable approaches ¾lb. The helping of plainly cooked greens generally served at table may have its Calorie value neglected, although its value in other respects must not of course be under-estimated. The same may be said of lettuce, celery or tomatoes, for which the 100 Calorie portion exceeds 1lb. The cooked vegetables in the American tables evidently include some unknown quantity of butter or other fat, and are therefore not included.

Made Dishes. These also are omitted, for the American recipes when available are generally different from English ones. A student will be able to work out her own from the recipes she uses; and Table B will help her to do so. But the study of the American figures brings out some interesting points. The 100 Calorie portion of "pie" is a section of a circular pie of 9 inches in diameter. (For this purpose it will certainly be convenient to make circular, not oval pies.) The section is only one inch at the circumference, coming to a point in the centre. One surmises that an ordinary helping will be about three times this, or 300 Calories. But we know nothing of the *depth* of the pie. Mrs. Rose's ice-cream gives 100 Calories in ¼cup; home-made sweets or "candies" give the same quantity in ¾ or $\frac{9}{16}$oz; according to which ¼lb. of fancy chocolates will give 450-500 Calories, or half a substantial meal.

Note on Table B

Table B is planned so as to give figures for rapid calculations of the Calorie and protein value of made dishes, according to their recipes, when the cook is working by measurement and not by weight. The weight of each ingredient is given, however, as a check to the measurement. And we should once again caution the student (as on p. 115) to check the contents of her own cup and spoon before making these calculations according to the figures in the table. The last edition of Mrs. Beeton (1923) gives on p. 64 a Table of Equivalents of measures and weights which does not correspond at all points with Table B, even allowing that her breakfast cup is 10oz. Sugar, flour, suet and breadcrumbs are much the same; tapioca, cornflour, grated cheese, currants show divergence. Mrs. Beeton's book gives *fat*—dripping, butter and margarine—as 7oz. contained in a 10oz. breakfast cup: these items are not found in Table B, and should be ascertained by trial if cupfuls of any of these fats are used.

Table B

(Taken chiefly from M. S. Rose, *Feeding the Family*).

Material	Measure in American Units	Wt. in Oz.	Total Calories	Calories in Protein	Remarks
Bread crumbs					
oven dried ..	1 cup	3½	373	52	
stale ..	1 cup	3	239	34	
Buttermilk ..	1 cup	8½	88	29	
Cheese, grated dry*	1 tbsp.	½	16	4	
	1 cup	2	249	65	
,, ,, fresh	1 tbsp.	¼	31	8	
	1 cup	4	498	130	
Cocoa	1 tbsp.	¼	35	6	
Cornflour ..	1 tbsp.	½	34	—	
	1 cup	4½	459	—	
Currants (dried)	1 cup	5½	502	15	
Egg (whole in shell)		2½	70	25	
1 white ..		1	14	13	
1 yolk ..		⅔	56	11	
Flour (wheat) ..					
unsifted ..	1 tbsp.	½	33	4	
	1 cup	4½	459	58	
sifted.. ..	1 tbsp.	¼	28	3	
	1 cup	4	395	50	
Macaroni					
uncooked ..	10 sticks 9″long	3½	355	53	
cooked ..	1 cup of pieces 1in. long	5½	100	15	
Milk (whole) ..	1 tbsp.	7/10	14	3	
	1 cup	8½	170	34	
skim	1 tbsp.	7/10	7	2	
	1 cup	8½	88	32	
Molasses or Syrup	1 cup	12	976	33	
Oatmeal ..	1 cup	5½	636	107	
Peel, candied chopped	1 cup	2½	263	2	
Raisins ..	1 cup	5	489	15	
Rice, uncooked	1 tbsp.	½	50	4	
	1 cup	7	696	63	
,, steamed ..	1 cup	5⅓	127	11	
Suet	1 cup	3½	749	19	
Sugar, brown ..	1 tbsp.	⅓	36	—	
	1 cup	5⅓	625	—	
granulated	1 tbsp.	½	60	—	
	1 cup	7⅔	840	—	
powdered	1 tbsp.	½	48	—	
	1 cup	6	672	—	
Tapioca ..	1 tbsp.	½	48	—	
	1 cup	6½	640	3	

CHAPTER IX

The Use of the Tables

Analyses of Made Dishes, of Daily Diets, and of Weekly Consumption

A few examples of the use of Table B will be given first, as calculations of the value of made dishes can be achieved more easily, though less accurately, on this method. In regard to all calculations, simple or complex, the student is advised to work out at first a fairly large number of problems, if she uses the tables at all; for naturally it is only practice that makes them easy or rapid; the first three or four will take some little time, both in looking up the data and in doing the calculation. But, after a few have been done, it will be found that such ingredients as flour, eggs, sugar, milk, occur so often that the figures for them are easily memorized, and altogether the whole operation becomes much more rapid.

Using Table B the following are examples of quickly worked out "cup" recipes :—

Ingredients	Calories	Protein Calories
Sponge Cake—		
2 cups flour	918	116
2 cups sugar ..	1680	—
4 eggs	280	100
2 teaspoonfuls baking powder ..	—	—
	2878	216

Ingredients	Calories	Protein Calories
White Cake—		
3 cups flour	1377	174
2 cups sugar	1680	—
3 eggs	210	75
1 cup butter (7oz. ?)	1526	7
1 cup of milk	170	34
	4963	290
Nut Cake—		
2 cups of sifted flour	790	100
1 cup sugar	840	—
2 eggs	140	50
1 cup butter (7oz. ?)	1526	7
1 cup milk	170	34
1 cup raisins	489	15
1 cup walnuts	600	68
1 teaspoon cream tartar	—	—
½ „ soda	—	—
	4555	274

It is possible also to make a much rougher estimate of the Calorie value of a mixture almost as a mental process, while one mixes it, by using the following very rough approximations to 100 Calorie portions.

100 Calories or 1 Portion are contained in—

1oz. flour, rice, macaroni, cornflour.
½oz. (*scant*) of fat.
One egg ; one large apple ; one potato.
2oz. raw lean meat.
1½oz. raw fat meat.
½oz. fat bacon.
¼pint milk.
2 tablespoonfuls sugar.

Then, while mixing 1lb. of flour with 6oz. suet for a suet crust, one would note there were 16+12 portions or 2800 Calories in the crust.

A recipe for apples and rice :—

½lb. rice	=	8 portions.
6 apples	=	6 ,,
2 tbsp.=1oz. butter	=	2 ,,
2 tbsp. sugar	=	1 ,,

1700 Calories.

Sago pudding :—

pint of milk	=	4 portions.
3 tbsp.=1½oz. sago	=	1½ ,,
2 eggs	=	2 ,,
2 tbsp. sugar	=	1 ,,

850 Calories.

We may next illustrate how to use Table A in ordering a meal, noting that the table, as it stands, does not include any puddings.

1.—A good lunch or dinner for a woman.

	Calories	Calories in Protein
2 slices of Roast Lamb ..	200	82
2 potatoes	200	22
Greens	—	—
Tinned Apricots ..	100	5
Cream	100	5
1 Roll ..	100	12
1 pat Butter ..	100	—
	800	126

Protein Calories 15½ per cent.

2.—A dinner for a man.

½ cup Thick Soup ..	100	4
1 piece boiled Halibut ..	100	61
3 slices roast Beef ..	300	138
3 Potatoes ..	300	33
Greens	—	—
Roll, Butter, Cheese ..	300	38
	1100	274

Protein Calories, 25 per cent.

This is unnecessarily large; a pudding would be better than the cheese.

MORE ACCURATE ANALYSES

Calculations based on the full Tables of percentage composition of foods are comparatively much more difficult and arduous than those given above. They must involve the manipulation of decimals. Never-

theless the computation of the food value of the food in a weekly family budget or of the meals taken by an individual in a day must be made by calculations of the more accurate kind ; and it will be found good practice, as well as contributory to the estimation of daily menus, to do made dishes in the same way.

The percentage numbers in the Tables give the *proportion* of protein, etc., in the food ; as they stand they are not weights at all. If flour is said to contain 10.1 per cent of protein then 10.1/100 or 101/1000 of the sample of flour was protein. Of 1oz. flour .101oz. was protein ; of 1lb. flour .101 lb. was protein. It must be decided at the beginning of the calculation whether one will estimate protein, fat and carbohydrates in ounces or in pounds. Pounds should be used only for weekly budgets, and these must be finally expressed in ounces when the amount per person per day has to be stated. The Calories in the tables are given always for pounds, and it will often be necessary to divide by sixteen to get Calories per ounce. It is very convenient for this purpose, and quite easy, to memorize the sixteen times table ; but the student may prefer to write Calories per ounce in the margin of her general food table.

In tabulating the value of a given weight of any food, look up the percentages in the Tables, and copy them down *with the decimal point moved two places to the left.* This will convert them from percentages into decimals of an ounce or pound, whichever you require. The figures are then ready to be multiplied by the *number* of ounces or pounds of the food.

Thus—for the food value of 6lb. of flour, to be given in pounds.

	% ÷ 100			lbs. of		
	Protein.	Fat	Carbo-hydrates	Protein	Fat	Carbo-hydrates
Flour 6lbs.	.101	.016	.755	.606	.096	4.530

Note that as the percentages are given with one decimal place, there will be three decimal places when the division by 100 has taken place. The percentages after division are multiplied each by 6, and three decimal places still appear in the statements of pounds. The figure for the carbohydrate retains its final 0 to make sure of keeping the three columns in the right position for addition. The initial 0 for the amount of fat must be clearly understood as the result of moving the decimal point *two* places to the left, when only *one* figure was in front of it.

Approximation. For computing the fractions of ounces of each kind of food in a made dish it will be quite sufficient to give two decimal places. We are not interested in less than the 1/100 part of an ounce of our food. So the set of figures to the right of our calculations for made dishes will always have two decimal places: the student can copy the percentages from the table with two or with three as she chooses. Sometimes it is necessary to put in the third figure to mention any quantity at all, as for instance in the "fat" present in onions; and no harm will be done by omitting the figure concerned with fat for the amount of onions contained in a made dish. The omission of the last figure is of course on the principle that up to 5 it is simply left out, if it is above 5, a unit is added to the figure in front. Thus .743 is written as .74 when abbreviated, but .748 is written as .75.

Recipes from Mrs. Beeton, Edition 1923.

A—Stewed Steak for four persons.

	% ÷ 100			Ounces of			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Steak, rump, 16oz.	.22	.07	—	3.52	1.12	—	715
Butter, 1oz. ..	.02	.83	—	.02	.83		219
Flour, 1oz. ..	.10	.02	.75	.10	.02	.75	104
Carrots, etc., 8oz.	.013	—	.096	.10	—	.80	102
			4)	3.74	1.97	1.55	1140
	Per portion			0.93	0.5	0.4	285

B—Toad in the Hole for four persons.

	% ÷ 100			Ounces of			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Steak, 16oz. ..				3.52	1.12	—	715
Flour, 4oz. ..	.10	.02	.75	.40	.08	3.00	416
Milk, 10oz. ..	.033	.036	.048	.33	.36	.48	189
Egg, 2oz.	.11	.10	—	.22	.20	—	82
			4)	4.67	1.76	3.58	1402
	Per portion			1.17	.44	.87	351

C—Haricot Mutton for four persons.

	% ÷ 100			Ounces of			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hydt'es	
Neck mutton, 32oz.	.19	.25	—	6.08	8.00		2836
Veg., various as							
carrots ..	.013	.001	.10	.21	—	1.6	205
Onions, 8oz. ..	.013	.001	.10	.10	—	.8	110
			4)	6.39	8.00	2.4	3151
	Per portion			1.6	2.00	0.6	790

The third meat recipe is surely intended for more than four persons; as each, according to the recipe, would have to eat half a pound of mutton, and one quarter of that or 2oz. would be fat. The Calorie value shows up much too high for a sensible single dish, and causes one to throw doubt on some of the data.

We shall give next some puddings. It will be noticed at once that the Calorie value of D and E is actually larger than that of the two meat dishes A and B. On looking more closely at the figures it is observed that this fuel value is given by carbohydrates and fats in D and E, while the protein value is very poor. In A and B, although the meat allowance is only ¼lb. per person, the meat is lean, and the protein value is good. In Calories it would amount to about 38 per cent. in both cases.

D—Ginger pudding for four persons.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Flour, 6oz. ..	.101	.008	.755	.60	.01	4.53	624
Golden Syrup, 6oz.	—	—	.764	—	—	4.56	534
Suet, 3oz. ..	.001	.933			2.80		741
Milk, ½gill 2½oz.	.033	.036	.048	0.7	.09	.12	47
			4	.67	2.90	9.18	1946
				.17	.75	2.29	486

E—Bread pudding for four persons.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Bread, 8oz. ..	.07	.01	.47	.56	.08	3.76	523
Raisins, 4oz. ..	.02	—	.56	.08	—	2.24	272
Suet, 2oz. ..	.001	.93	—	—	1.86	—	494
Sugar, 2oz. ..	—	—	1.00			2.00	232
1 Egg, 2oz. ..	.11	.10	—	.22	.20	—	82
			4	.86	2.14	8.00	1603
				.21	.53	2.00	401

F—Sago pudding for two persons.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Milk, ½pt., 10oz.	.033	.036	.048	.33	.36	.48	190
Sago, 1oz. ..	.002	—	.86			.86	104
Sugar, 1oz. ..						1.00	116
			2	.33	.36	2.34	410
				.16	.18	1.17	205

Soup. It is not very easy to select a soup recipe which will be a useful example. If it is made with meat, the food value of the meat cannot be brought into the total, unless all the meat used is cut up small and served in the soup. Otherwise, as we have seen already, only a small part of either protein or fat passes into the soup, and the latter, or both, may be skimmed off during cooking. A vegetarian recipe has therefore been selected from Mrs. Beeton's book.

Potato Soup for 4 or 5 persons. This is made with "second stock" or water. The food value of the former can be neglected.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Milk, ½pt., 10oz. ..	.033	.036	.048	.33	.36	.48	189
Potatoes, 16oz. ..	.018	—	.188	.29	—	3.00	386
Onion, 1, 6oz. ..	.013	.001	.103	.07		.62	82
Butter, 1oz. ..	.002	.833	—	—	.83	—	219
Sago, 1lb. and ¼oz.	.002		.877	—	—	.22	26
			4	.69	1.19	4.32	902
				.17	.30	1.08	225

This is quite a contribution to a meal, but is very weak in protein (barely 9 per cent. in Calories) and needs supplementing by a dish rich in protein. In the previous editions a tomato soup was analysed which gave only 146 Calories; this one is enriched in Calories by the starch of the potato.

VEGETARIAN RECIPES.

1.—From Mrs. Beeton.

Rice and Cheese croquettes for six persons.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'es	
Rice, 6oz. ..	.068	.006	.800	.41	.04	4.80	615
Milk, 1pt., 20oz. ..	.033	.036	.048	.66	.72	.96	378
Butter, 1oz. ..	.002	.833	—	—	.83	—	219
Cheese, 1oz., (2tbs.)	.257	.350	.031	.26	.35	.03	126
Eggs, 2, 4oz. ..	.111	.101	—	.44	.40	—	164
			6	1.77	2.34	5.79	1502
				.30	.39	.96	250

Moderate fuel value, but a good proportion is in protein. .3 of an oz. of protein gives 34.8 or 35 Calories out of 250, which is 14 per cent.

The quantity of cheese is small, though this is partly made up for by 2 eggs. The next recipe is from *Economical Dishes for Workers**, and is a more substantial dish, owing to its good allowance of cheese. Mrs. Beeton's croquettes would make only a small portion of a dinner.

* Food Reform Association Pamphlet, issued 1916.

2 Semolina Cheese for six persons.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Semolina, 6oz. ..	.114	.011	.753	.68	.06	4.50	624
Milk, 1pt., 20oz.	.033	.036	.048	.66	.72	.96	378
Cheese, 8oz. ..	.257	.350	.031	2.06	2.80	.24	1005
Egg, 1, 2oz. ..	.111	.101	—	.22	.20	—	82
			6	3.62	3.78	5.70	2089
				.60	.63	.95	348

Protein Calories about 20 per cent.

Cakes. The following examples (both from Mrs. Beeton) are worked out as demonstrations, but remain incomplete, as the weight of the material after cooking is unknown, and the number of portions not determined.

Economical Cake	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Flour, 16oz. ..	.10	.016	.75	1.60	.25	12.00	1660
Castor Sugar, 4oz.	—	—	1.00			4.00	465
Fat, dripping or lard 1oz. ..	—	—	4.00		4.00		1050
Currants, 8oz. ..	.02	—	.56	.16	—	4.48	545
Eggs, 2, 4oz. ..	.11	.10		.44	.40		164
Milk, 10oz. ..	.033	.036	.048	.33	.36	.48	189
				2.53	5.01	20.96	4073

Protein Calories 7.2 per cent.

Almond Icing	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Castor Sugar, 16oz.	—		1.00	—	—	16.00	1860
Ground almonds, 12oz	.19	.55	.16	2.28	6.60	1.92	2285
Eggs, 2, 4oz. ..	.11	.10	—	.44	.40		164
				2.72	7.00	17.92	4309

This icing is said to be enough for a cake weighing 2 or 3lb., and itself weighs nearly 2 lb. It should be noted that it is a form of food quite rich in carbohydrate (sugar) and fat, and therefore in Calories, though the protein Calories are only 7.3 per cent. Two ounces of it (weighed uncooked) give 268 Calories.

In the calculations which follow, the percentage columns are omitted, as they have now been quoted for most important ingredients mentioned.

ECONOMICAL TWO COURSE DINNERS

Taken from the Report on the Cost of Living of the Working Classes in Yorkshire, 1909.

The recipes are for Man, Wife and five children of average age 10 (equivalent to 4.8 adults).

1. Yorkshire Cheese Pudding and Bean Gravy
   Buttered Rice,

		Ounces			Calories
		Protein	Fat	Carbo-hydrates	
Milk, 1pt., 20oz.		.66	.72	.96	378
Eggs 2, 4oz.		.44	.40	—	164
Flour 8oz.		.81	.02	6.04	830
Cheese 8oz.		2.06	2.80	.24	1005
Margarine 1oz.		—	.85	—	224
Beans 4oz.		.71	.02	2.58	38
Onion and Carrot, 4 oz.		.05	—	.40	53
	4.8	4.73	5.01	10.22	3040
Per adult portion ..		.98	1.04	2.10	633
Rice, 6oz.		.41	.04	4.80	615
Sugar, 2oz.				2.00	232
Margarine, 2oz.		—	1.70	—	448
	4.8	.41	1.74	6.80	1295
Per adult portion.. ..		.08	.36	1.42	270
Whole meal for one adult ..		1.06	1.40	3.52	803

Protein Calories about 15 per cent.

2 Fish and Potato Pie with sauce, Green Peas (dried) Blancmange and Jam.

		Ounces			Calories
		Protein	Fat	Carbo-hydrates	
Fish without bone, 2lb., say 2½ with bone, 40oz.		5.44	.48	—	730
Potatoes, 3lb.		.86	—	9.02	1158
Margarine, 3oz.		—	2.53		672
Flour, 2oz.		.20	—	1.51	208
Milk, 5oz.		.16	.18	.24	94
Peas, 12oz.		2.44	.08	7.56	1100
Sugar, 1oz.				1.00	116
	4.8	9.10	3.29	19.33	4078
Per adult portion ..		2.90	.68	4.03	850
Cornflour, 2oz.		.01	—	1.75	203
Sugar, 1oz.		—	—	1.00	116
Milk, 25oz.		.80	.90	1.20	470
Jam, 4oz.		.01	—	2.78	324
	4.8	.82	.90	6.73	1113
Per adult portion ..		.17	.19	1.40	232
Whole meal for adult		2.07	.87	5.43	1082

Protein Calories, 22 per cent.

DAILY DIETS

The best daily diet for analysis still seems to be the one given in Dr. Bryce's Dietetics. It may be taken as that of a rather abstemious professional man who takes ordinary English food, and has a substantial breakfast, a light lunch and plain late dinner (or vice versa) and does not have at all large helpings. The number of Calories is nevertheless a little more than that which would be prescribed to him ; and his consumption of fat is large compared with that of carbohydrates, which brings up the total of Calories. The proportion of protein Calories is 13.5, a quite good figure. The supply of vitamines for an adult ought to be quite satisfactory, as he has a fair amount of milk, with butter, egg, green vegetable, tomato, cooked and raw fruit.

The tomato soup figures are taken from a calculation made in the last edition ; the sago pudding from p. 134.

Probably some of the potato protein was not utilised, if they were peeled and boiled ; but the amount is not great in any case. Similarly the " fat " in prunes, apples and cauliflower might be left out without altering the result appreciably.

	% ÷ 100			Ounces			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Banana, 3½oz. ..	.006	.001	.14	.020	.003	.490	58
Porridge ¾oz. Oatmeal	.119	.086	.70	.090	.065	.530	118
Milk, 6oz. ..	.033	.036	.048	.198	.216	.288	142
Bacon, 2oz.	.09	.526	—	.182	1.052	—	299
Egg, 2oz.	.11	.10	—	.220	.200		82
Marmalade, ¼oz. ..	—	—	.439	—	—	.110	20
Sugar, 1oz. ..				—	—	1.000	116
Bread, 9oz. ..	.07	.01	.474	.630	.09	4.276	588
Butter, 1oz.	.002	.830	—	.002	.830	—	219
Cream, ½oz. ..	.004	.50	—	.002	.250	—	66
Tomato Soup ..				.156	.261	.511	146
Roast Beef, 4oz. ..	.223	.286	—	.892	1.144	—	405
Potatoes, 3oz. ..	.018	—	.188	.054	—	.564	72
Cauliflower, 3oz.	.010	.001	.030	.031	.003	.093	15
Sago pudding ..				.160	.180	1.170	205
Stewed Prunes, 2oz. dry ..	.025	.002	.339	.050	.004	.678	25
Sugar, ½oz. ..						.500	58
Cheese, ½oz. ..	.257	.350	.003	.064	.022	—	31
Biscuits, ½oz. ..	.08	.088	.700	.040	.044	.350	58
Fish, 5oz. ..	.136	.012	—	.680	.060	—	91
Baked Apple, 6oz	.003	.002	.098	.018	.012	.588	79
Sugar, ½oz. ..						.500	58
In whole diet				3.489	4.436	11.648	3011

WEEKLY BUDGETS.

One example of these should be sufficient. The budget selected is from the Sumner Report of Cost of Living of the Working Classes, 1918, and is a budget from 1914. The quantities are averages from a large number of selected budgets, and therefore appear expressed in decimals, to tenths or hundredths of a pound. If an actual budget is taken, pounds or ounces will most likely be given instead of these decimals. This one is called a " standard " budget for a " standard " family which is 4.57 adults. Decimals to three places are used in the calculations, because of the large quantities ; and the protein, fat and carbohydrates are first expressed in decimals of a lb., and brought to ounces before the divisions (by 7 and by 4.57) are made.

The result here as the daily diet for a working man compares badly with Dr. Bryce's professional man's diet. The Calories here are too low—they ought to be about 3300 ; the fat is insufficient, and the protein Calories percentage even on the too low Calories is only 10.6. A diet richer in protein is needed ; some more food in actual quantity and more vegetables and fruit.

SUMNER BUDGET, 1914

	% ÷ 100			lbs.			Calories
	Protein	Fat	Carbo-hyd'tes	Protein	Fat	Carbo-hyd'tes	
Bread, 33.5lb. ..	.07	.01	.474	2.345	.335	15.879	35041
Meat, 6.8 lb. ..	.152	.190	—	1.034	1.294	—	7392
Bacon, 1.2 ,, ..	.091	.526		.109	.631	—	2866
Dripping, etc 1.0lb .		1.00			1.000		4219
Eggs 13, 1.6lbs...	.111	.101	—	.178	.162	—	1066
Milk 9.2p. 11.5lb.	.033	.036	.048	.379	.414	.552	3478
Cheese, .84 lb. ..	.257	.350	.031	.216	.294	.026	1689
Butter, 1.7 ,, ..	.002	.830	—	.003	1.411	—	5955
Margarine, .42lb.	.002	.848	—	.001	.356	—	1503
Potatoes, 15.6,,..	.018	—	.188	.281	—	2.933	6027
Rice, etc. 1.4 ,,..	.068	.006	.800	.095	.008	1.120	2296
Oatmeal, 1.3 ,,..	.119	.086	.700	.155	.112	.910	2452
Cocoa, .18 ,,..	.181	.268	.403	.033	.048	.073	399
Sugar, 5.9 ,,..	—	—	1.000	—	—	5.900	10974
				4.829	6.065	27.393	85357

	Protein	Fat	Carbo-hydrates	Calories
In ounces	77.264	96.440	438.288	
Per day (÷ 7)	11.038	13.777	62.612	12194
Per man (÷ 4.57)	2.42	3.01	13.70	2668

In the original budget a small amount of money is allowed for possible vegetables, fruit and jam, a rough computation of the food value in these additions will make the final figure for carbohydrates 14.20, and thus raise the Calorie figure by about 60 units.

APPENDIX

Calculations often Needed

I. To calculate what percentage of the total calories is yielded by the protein content of a dish, a meal, or a particular food.

This figure takes the place of what used to be called the nutritive ratio.

After calculations have been made giving the analysis of the food as in Chapter VIII, the protein will usually be expressed in ounces, and to two decimal places. At any rate it will not be necessary to take three decimal places.

Example: A certain pudding is found to yield 2885 Calories, and to contain 1.83 ounces of protein. One ounce of protein gives 116 Calories. The arithmetical operation necessary is

$$\frac{1.83 \times 116 \times 100}{2885}$$

As we have to multiply 1.83 by 100, the decimal point can be eliminated, and the operation becomes

$$\frac{183 \times 116}{2885}$$

Answer: 9, or more accurately 9.3 per cent.

II. The analysis of a food being given in percentages of protein, fat and carbohydrate, to find the total calories for one oz. and one lb.

On p. 99 the analysis of maize grain is given as:

P.	F.	C.
9.9	4.2	72.5

thus one ounce of maize consists of .099P. .042 F. .725C.

Proteins and carbohydrates each yield 116 Calories per oz; fats 263 Calories.

$.099+.725=.824$ $.824\times116=95.6$C.

$.042\times263=11.0$C.

Nearest whole number of Calories, 107.

Maize yields 107 Calories per oz.; or 1712 C. per lb. Some approximate method should be used for the multiplications, as no more than three figures will be needed.

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